NOTHING TO DISAGREE ABOUT: ARISTOTLE, NEWTON, AND THE EXISTENCE OF VOID AS SEEN THROUGH A KUHNIAN LENS

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DISSERTATION

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ABSTRACT

In this work, I argue that a doctrine of theoretic incommensurability, something like that offered by Thomas Kuhn, can be used to to explain the disagreement between Aristotle and Isaac Newton regarding the existence of void. A significant portion of the work is directed at identifying Kuhn's mature conception of theoretic incommensurability and at diagnosing an apparently serious problem with the account, namely its susceptibility to the charge of epistemological relativism. To combat the charge, I develop an ontology and theory of cognition that can support the Kuhnian thesis without requiring one who prefers the view to accept a strong form of scientific relativism (i.e., scientific subjectivism). Nonetheless, enough conceptual freedom is left to substantiate the incommensurability thesis. Once I have shown that Kuhn's conception is sustainable, I put the theory into action. First, I present the views of both Aristotle and Newton on the existence of void. Then, I show that they diverge in exactly the way that leads to incommensurability according to the Kuhnian account. The end result is that both Aristotle and Newton are shown to have empirically acceptable positions even though they disagree.

To my sister, Tara,
my wife, Julie,
and my children, Eva, Elise, Layla, and Oliver

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TABLE OF CONTENTS

CHAPTER ONE:
INTRODUCTION

1.I MY MOTIVATION

There are a number of perennial problems in the study of philosophy. Many of these are quite familiar to anyone with a passing knowledge of the subject: Does God exist? What can we know? What is the good? These are the sorts of questions that get addressed in most courses that introduce the discipline. However, there are other perennial problems that have received much less fanfare. One such problem is the question of whether or not there exists some region of space in which no material being is present – whether or not there is void. Not only do questions such as this tend to go unnoticed by non-philosophers, but even many in the philosophical community seem not to have a serious concern for this topic. Nonetheless, the history of both Western philosophy and science is littered with creative and interesting arguments both for and against the existence of void.

For example, among the Presocratic atomists, it was contended that motion would be impossible if void did not exist. But, they reasoned, since motion is clearly perceived, it should be inferred that void obviously exists. In response, Aristotle would counter this pro-void claim by arguing that void was not actually needed to explain motion. In fact, he would go on to propose that the very idea of void is an incoherent one, and thus that the spatial expanse is a plenum of material substance. The Aristotelian and atomistic camps would be at odds throughout the late ancient and medieval periods.

Even the collapse of classical natural philosophy following the scientific revolution in the sixteenth and seventeenth centuries would not send the void-problem into obscurity. For, in the

early-modern period, disagreement on the issue was as pervasive as ever. For instance, Rene Descartes would treat the existence of a universal aethereal plenum (universal non-void) as a mechanical necessity for anyone who wished to maintain a doctrine of planetary motion. On the contrary, Isaac Newton would challenge the view, arguing that the Cartesian positions regarding both motion and space make geometry and physics impossible. In short, Newton, like Aristotle, seemed to think that there is a conceptual incoherence involved in the opposing view – only Newton disagreed with Aristotle as to which side of the controversy was committing the intellectual error!

Newton was not without his own detractors either. Many scientific mechanists in the period of the development of Newtonian physics, for example James Clerk Maxwell in the nineteenth century, considered a commitment to void space to be an empirically unacceptable hypothesis given the modern interpretation of light as a wave phenomena. For, it would be argued, if light really ought to be understood as communicated in waves, as was thought to be the case, then it seems unreasonable to reject the existence of an underlying material medium. Analogically, try and imagine an ocean wave being propagated, but without the water. Is this imaginative task even conceivable? It doesn't seem so. But even if it is, it is clearly hard to imagine it being mechanically possible. In short, the pro-void theorist is on the hook to explain what makes it possible that light could propagate in waves without a material substratum. This substratum came to be known as ether.

But the mechanists have not had the final say on the matter either. Such great scientific thinkers as Albert Einstein, Albert Michelson, and Edward Morley have all doubted the reality of an ethereal plenum. And they seemed to have good empirical reason for their doubt, having devised tests (e.g., the Michelson-Morley Experiment) to verify the non-presence of a subtle

material substance in interplanetary space. Hence, for the greater part of the twentieth century, scientists generally agreed that the presence of ether is doubtful. Nonetheless, even today, some wonder whether admitting of an ethereal substance would allow for a better explanation of a number of currently underdeveloped features of the scientifically conceived universe, including but not limited to field phenomena, space-time substantiality, and cosmic background radiation.

Now, the present work is not aimed to resolve the problem of void's existence. Instead, I wish to propose some evidence for a theory about *why the problem has become perennial one* and *why it will remain that way*. In short, my theory is that the historically proposed solutions to the general question of whether or not void exists do not rest solely upon the empirical evidence, but rather upon non-empirical (yet empirically consistent) assumptions that drive the research of disagreeing scientists in different directions. That is, some scientists adopt assumptions that lead them (appropriately) to reject the existence of void and some scientists adopt assumptions that lead them (appropriately) to accept the existence of void. What's more, these adopted assumptions are not without some utility of their own, aside from the question of void's existence. For most of them were originally adopted because they proved to be quite useful in solving other (often more pressing) scientific problems. Thus, the commitment to the existence or non-existence of void turns out to be an implicative necessity rather than an original desired end. Hence, addressing the disagreement and establishing the empirically-correct answer to the void question is not simply a matter of getting one group of thinkers to simply drop their assumptions in favor of a commitment to the sensible evidence, nor is it a matter of convincing those people that they should be dissatisfied with their present solution. A more pervasive problem is at hand.

Now to have a set of underlying assumptions that drive one's inferences has been called "having a conceptual scheme."[1] And some have proposed that having a conceptual scheme that differs from the scheme of another leads to an insurmountable state called incommensurability. Thomas Kuhn is the most influential thinker to explicitly make this claim. In this work, I present the groundwork for the argument that the doctrine of theoretic incommensurability offered by Thomas Kuhn is able to explain the disagreement concerning the existence of void. Of course, to take on the entire project, to show that the Kuhnian account explains away *all* of the independent arguments on the matter, cannot be successfully achieved here. The arguments are many and the space is limited. Thus, my specific program is to give a small piece of the the total project and to focus in on the two of the more influential (yet opposing) positions that have been offered: the anti-void doctrine of Aristotle and the pro-void doctrine of Newton. If my account is successful, then it seems reasonable to postulate that the other major arguments for or against the existence of void *may be* the products of incommensurability as well. Therefore, justification for further inquiry is substantiated.

I begin the project by first identifying Kuhn's mature conception of incommensurability (Chapter 2). Once this has been accomplished, I go on to diagnose and respond to an apparent problem with the account, namely its susceptibility to the charge that it entails a severe form of relativism (Chapter 3). But my preliminary response requires its own development so, to fully answer the charge, I develop an ontology and theory of cognition that can support my rendition of the Kuhnian thesis (Chapter 4). Once I have shown that my conception is sustainable, I present the historical arguments of both Aristotle (Chapter 5) and Newton (Chapter 6) on the

[1]See Donald Davidson, "On the Very Idea of a Conceptual Scheme" in *Proceedings and Addresses of the American Philosophical Association*, Vol. 47 (1973-1974).

existence of void. Finally, I show that Aristotle and Newton clearly disagree in exactly the way that leads to theoretic incommensurability according to my account (Chapter 7).

Finally, in addition to being a lynchpin towards explaining the disagreement between Aristotle and Newton, and in addition to being a justificatory ground for further inquiry concerning the assessment of other historically diverse, yet incompatible arguments concerning void's existence, I believe that the Kuhnian doctrine of incommensurability as it is developed here is capable of being fitted to explain all sorts of perennial disagreements, not just those that are introduced in natural philosophy, or science. That is, I think that theoretic incommensurability has some promise towards explaining disagreements concerning problems in natural theology, revealed theology, ethics, politics, psychology, sociology and even mathematics. In short, I see it as a nice element of an empirically adequate natural epistemology. Again, to defend this thesis would require a lifetime of work, not just a doctoral thesis. Nonetheless, I find it worth mentioning if only to inspire an appreciation for the upshot of the present work.

1.II A PRELIMINARY DISCUSSION OF THE WORK

In what follows, I explain the unfolding of my project, chapter by chapter. I have chosen to include the following section for three reasons: (1) to give a quick up-front summary of the progression of the work, (2) to help explain some of my textual decisions, and (3) to place my arguments within a broader context whenever it seems fitting. Regarding (1), because this section is summative, I take it to be lacking in overall persuasiveness and total clarity. That is, the rest of the work will unpack the vague ide

a of the work that the reader is left with after reading this section. Nonetheless, the main points and concepts will be clearly identified. Regarding (2) and (3), I see my approach here as helping the chapters themselves to maintain a more natural evidential flow as they unfold into one another. To include some of the background information and motivational concerns of the project within the main context of the work, I think, would lead the reader to get bogged down. There are already more than enough historical and theoretical details to grasp, so to increase the in-text information therein would likely do more harm than good.

1.II.A Introduction to Chapter Two

In Chapter Two, I present Thomas Kuhn's theory of incommensurability. However, I begin the chapter with an account of Kuhn's doctrine of "paradigms." I start with an account of paradigms because a difference of paradigms turns out to be the reason for the distinct theoretic results that ultimately lead to incommensurable positions. Thus, paradigms ground the state of incommensurability. I begin that section by describing the original understanding as it is found in *The Structure of Scientific Revolutions* (*SSR*). I go on to show how the doctrine was clarified in "Second Thoughts on Paradigms" (ST).

After presenting Kuhn's doctrine of paradigms, I go on to give an account of the doctrine of incommensurability as it was originally (and vaguely) expressed in *SSR*. I start here because this is the best point of contact with most of my likely readers; I agree with Jeffrey McDonough when he proclaims that "Kuhn's most mature view of incommensurability remains largely unexplored by his commentators." [2] According to the *SSR* account, I determine that incommensurability is marked by the following fundamental features: (i) it is a relational property that stands between paradigms, (ii) it signifies the existence of a set of unresolvable

[2]Jeffrey McDonough, "A "Rosa Multiflora" by Any Other Name: Taxonomic Incommensurability and Scientific Kinds," in *Synthese* 136.3, 355.

differences, (iii) these differences are at least partly a result of the fact that different paradigms employ different conceptual and linguistic structures, (iv) proponents of different paradigms live in "different worlds," and (v) the transition from one world to another requires an immediate conversion-like experience.

After explicating the doctrine of incommensurability as it appears in *SSR*, I point out four pressing problems that arise for the Kuhnian position. I dub these problems as the Inconsistency Problem, the Developmental Problem, the Relativism Problem, and the Scientific Progress Problem. After acknowledging the problems, I frame the development of the incommensurability doctrine as a series of responses to those concerns.

The Inconsistency Problem was clearly the most pressing for Kuhn in the early years of his theoretical expansion. In fact, his response to this problem serves as the basis for his proposed solutions to the others. The problem can be expressed as follows: Kuhn's doctrine of incommensurability is inconsistent because (a) it entails that proponents of incommensurable views are unable to understand one another, and yet (b) Kuhn himself goes on to try to make them understandable for his audience. One of the forerunners of this charge was Donald Davidson.[3] Kuhn responded to such detractors by distinguishing between translation and interpretation, and by arguing that those who saw his doctrine as inconsistent were interpreting his claims as if incommensurable conceptual schemes were meant to entail untranslatability. On the contrary, Kuhn intended that different conceptual schemes be understood as translatable, yet unable to be fully interpreted, one into the other, without *truth-functional* residue or loss. Another way of putting this is to say that paradigmatically indexed propositions, on a Kuhnian view, can be uttered and compared under a common language (i.e., the historian's lexicon) only insofar as a concern for truth was not involved. Because the Kuhnian understanding of

[3] Donald Davidson, (1973-1974).

incommensurability involves a concern for the truth-functionality (or world-applicability) of a conceptual scheme, it has come to be identified as "taxonomic incommensurability."

I think that Kuhn's clarification of his incommensurability doctrine was successful in undermining the Inconsistency Problem. It also makes an evasion of the Developmental Problem easy, as will be seen in §2.II.D.2. What's more, the clarification carved a path towards evading the relativism problem, but this path, as forged by Kuhn, is in need of significant development. Thus, I give only a cursory description of the solution in Chapter Two with a promise to provide a more in-depth response in Chapters Three and Four. Finally, the clarification also establishes a rough path towards a solution to the Scientific Progress Problem. I offer a sketch of this solution as well, though that response is also in need of significant development if it is to be fully appreciated. However, I do not address the issue again in this work, but I do see my development of Kuhnian doctrine as capable of grounding a reasonable solution.

Before moving on to discuss Chapter Three, I think it is worth acknowledging a certain developmental decision that I have made here that would stand out as an obvious exclusion to those familiar with the incommensurability literature. Within that literature, a distinction is made between epistemological incommensurability and methodological incommensurability. In short, an instance of epistemological incommensurability concerns whether a conceptual scheme fits the empirical evidence whereas an instance of methodological incommensurability concerns how to make a decisions between distinct schemes. That is, the methodological problem focuses on values other than mere fittingness.[4] I think that methodological incommensurability is a very

[4]In the Postscript (P) to *SSR*, which was written after ST, Kuhn reiterates basically the same description of paradigms that was expressed in the latter work. However, in P, he includes an constituent of paradigms understood in a broad sense – values. According to Kuhn, these are more widely shared throughout the broader community of natural scientists. The most important kind of value seems to be the predictive ability of a paradigm. A second kind of value concerns the various judgments which can be made about the abstract features of a paradigm and includes such factors as simplicity, consistency, plausibility, and compatibility with other elements in one's paradigm. A third sort of value mentioned is utility.

important topic to discuss for one who is interested to give a fuller response to the progress problem. But this is not my concern here since I do not wish to decide whether the Aristotelian or Newtonian position, supposing they both fit the raw empirical data, is the better. As such, I have decided not to include an in depth discussion on either methodological incommensurability or the deeper scientific values.

1.II.B Introduction to Chapter Three

Chapter Three is meant to expand upon and begin responding to the charge of relativism that was first identified in Chapter 2 (§2.II.C.3). The method I use is to consider a pair of strong, yet easily understandable arguments found in the literature on Kuhnian incommensurability and to argue that Kuhn is being misconstrued in some way in each case. This chapter does not completely alleviate the Relativism Problem though, as a new problem arises based upon the development of the rendition of Kuhnianism that I propose. I call this new problem the Tethering Problem. I respond to it in Chapter Four.

In the first section of Chapter Three, I begin by explaining that I am not trying to show that Kuhnian doctrine can evade relativism simpliciter, but rather that it can evade a very distinct form of relativism which I identify as "total-relativism." Total relativism is just one stop on a gradated scale that I characterize early in the section. After identifying the main features of this variety of relativism and contrasting it with other stops on my scale of relativism, I go on, in the second and third sections of the chapter, to consider two influential arguments that attempt to saddle Kuhnianism with what I have identified as total-relativism.

The second section of Chapter Three addresses an argument made by Robert Nola charging that total-relativism is a necessary consequence of Kuhn's commitment to idealism. Assuming that scientific idealism is understood as the view that scientific terms (e.g., universal

concepts, laws, or other abstract notions) do not specifically refer to objects or events in the external world (universals or abstract beings), but rather, that they are, in an important sense, merely mind-dependent representations of such things, then I acknowledge with Nola that Kuhn is, in fact, best understood as a sort of idealist. Nonetheless, I disagree with Nola's contention that the Kuhnian version of scientific idealism leads to a "radical form relativism," as he so emphatically proclaims.

Specifically, Nola pins the implication of total-relativism upon what he takes to be a non-standard notion of reference that the Kuhnian idealist is, supposedly, required to adopt. Now, a standard view of reference is one in which scientific concepts can be put in touch with the real (wholly external) world. This real world is identified as the object-sided world later in this work. The scientific realist may consider this to occur via a direct connection, and so the object-sided world may be taken to really contain universals and other abstract beings. On the contrary, a typical non-Kuhnian scientific idealist takes reference to occur via an indirect connection – a connection formed on the basis of some chain of concepts, the most fundamental of which are directly grounded in the object-sided world. Thus, the typical idealist may maintain that many (perhaps most) scientific terms are non-referential, but that these are grounded in the world via an observation language constituted by really referring terms. However, Kuhnian idealism allows for neither sort of connection to the object-sided world because Kuhn rejects the reality of both abstract beings and an observation language. Thus, it seems that one promoting a Kuhnian model must either deny reference altogether or adopt a non-conventional understanding of it.

Now, denying reference altogether would lead directly to subjectivism, as a science unconnected to its object would be a mere fiction; and the author of fiction is obviously free to create in accordance with his subjective whims. But this is the implication that I want to avoid,

for I consider total-relativism to be a type of subjectivism. So the reference-denial path will not do. Thus, I need the object-sided world to limit scientific conceptualization in some meaningful way. But if scientific terms are to refer to anything, what can be their object of reference? Kuhn consistently maintains that a less-real, paradigmatically informed world is the object of scientific reference. Such a world is identified as a subject-sided world in the later chapters of this work. Now a subject-sided world is admittedly distinct from the object-sided world. Hence, Kuhnian scientific terms refer to a world that is not identical to the object-sided world. And since standard views of reference take the referring object to be object-sided, it seems clear that Kuhn does, in fact, adopt a non-standard view of reference. What's worse, the non-standard account does not seem to help Kuhn to avoid the total-relativism worry anyway. For he also admits that there are many subject-sided worlds, and that these are often inconsistent with one another. And since the real world cannot be the sole cause for inconsistent construals of it, it stands to reason that distinct subject-sided worlds must be, in some sense, determined in a non-objective manner. Hence, Kuhnian doctrine, unless it can tether object-sided reality to each of the diverse subject-sided worlds, appears to devolve into total-relativism.

Once this problem is forcefully established, I go on to argue that the notion of reference that best fits Kuhnian idealism is not totally non-standard in the way proposed by Nola. I argue that Nola has mistakenly treated the Kuhnian view, that scientific terms refer to subject-sided worlds, as a rejection of the common view that the object sided world *is the ground* for scientific thought. Instead, I contend that the Kuhnian idealist upholds a standard of referential adequacy that simultaneously retains the common view of the object-sided world as the ground of science while admitting of a secondary form of reference that stands between scientific terminology and

a subject-sided world. In short, Nola treats Kuhnian reference as deflationary whereas I treat it as inflationary.

In the second section of Chapter Three (§3.III), I take on a distinct construal of Kuhnian doctrine as total-relativism. This argument, developed by Howard Sankey, characterizes Kuhn as an antirealist. I explain why antirealism might be thought to imply total-relativism and I am not concerned to challenge this assumption. Therefore, in order to evade the charge in this case, I simply challenge Sankey's characterization of Kuhn as an antirealist.

In sum, Sankey claims that Kuhn fails to meet what he takes to be the four conditions of a non-antirealist position.[5] Now, the argument provided by Sankey is generally a textual one. Suffice it to say that I think that Sankey makes a strong surface-level case that Kuhn is, in fact, antirealist according to Sankey's characterization. However, since Sankey is a fan of taxonomic incommensurability, he does not want to leave the textural criticism of Kuhn as the end of the story. Instead, he goes on to provide what he takes to be an appropriate path towards evading antirealism without rejecting incommensurability. The thrust of his proposed solution is the adoption of a causal theory of reference for scientific terminology, which provides Sankey with a sort of observation language.

Of course, the Kuhnian idealism that I defend in §3.II is inconsistent with this proposed solution since it involves an inherent denial of both the causal theory of reference *with respect to scientific terms* and an observation language that can ground theoretical terms. Thus, I must challenge the textual case that saddles Kuhn with antirealism, and thus total-relativism. I provide this case in §3.III.C.1. After this has been accomplished, I respond to Sankey's abandonment of Kuhnian idealism by showing that his concerns are actually based upon a misunderstanding and,

[5]I do not attempt to challenge the relation of non-antirealism to these four conditions, thus I aim to simply show that Kuhn does not fail to meet them.

thus, that there was no need to appeal to the causal theory of reference or an observation language in the first place. The gist of both my textual response as well as my response to the abandonment move by Sankey is that if one takes seriously (1) the relationship of an enriched conceptual scheme (i.e., the historian's lexicon) to truth, and (2) the character of Kuhnian idealism as developed in §3.II, especially the theory of reference that I develop there, then the stated problems can be explained away in a satisfactory manner.

In conclusion, in Chapter Three I propose that Kuhnian doctrine, as correctly interpreted, does not entail total-relativism. Rather, it is a non-antirealist, scientific idealism. I admit that my characterization would not be satisfying for Nola or Sankey since they each have clear aversions to a strongly idealistic view of science. Nonetheless, whatever their thoughts on that matter might be, unless idealism itself can be shown a *rationally problematic* epistemic thesis, rather than just an uncomfortable one given their own personal dispositions, then it stands to reason that the Kuhnian view that I develop evades the first stage of the total-relativism challenge.

1.II.C Introduction to Chapter Four

Whereas Chapter Three addresses the charge of total-relativism, my proposed solution inspires a deeper set of worries surrounding the issue of how to make it possible that scientific knowledge could be about the real world without referring to it. In Chapter Four, I address these worries by developing a possible ontology and theory of cognition that can sustain the idealist Kuhnianism that I am defending.

I begin my account by addressing the idea that Kuhn is basically promoting a form of Kantianism. Kuhn himself made a connection between his doctrine and Kant's. So have some of Kuhn's most important interpreters, for example Paul Hoyningen-Huene and Eric Oberheim. In fact, the connection seems highly appropriate. For it is quite clear that Kuhn viewed scientific

experience as an effect of the structuring activity of an intelligent being who gives the raw data of direct empirical experience a specific scientific character. In other words, Kuhn seems to adopt something like the infamous distinction between the noumenal world and the phenomenal world that was first proposed by Kant. The inability to connect these worlds together is famously known. Hence, the Tethering Problem is serious.

But I argue that the connection with Kant is, at times, overstated. In short, there are two reasons that my account of Kuhnian doctrine is significantly distinct from Kant's. First, the idealism of Kuhn, as I formulate it, does not require that the object-sided world be taken as a mysterious, pre-perceived thing-in-itself, like the noumenal realm of Kant. Rather, the object-sided world is directly experienced. Second, the object-sided and subject-sided worlds turn out not to be entirely distinct objects of experience at all in my version of Kuhnian idealism (not that they are necessarily so in Kant's view, though they are often treated as such). Rather a single scientific experience is taken to be constituted by distinct object-sided and subject-sided *moments* of experience.

Concerning the first qualification, I contend that the structures of Kuhnian experience are lower-level structures than those adopted by Kant. For Kant, time, space, and substantiality are treated as basic structures of cognition, and so are features that are added to one's experience of the world instantaneously. That is, the noumenal world itself is thought to be neither temporal nor spatial, even if never experienced in an atemporal and non-spatial way. It is no wonder that it is treated as a mysterious world! On the other hand, Kuhnian scientific experience does not involve the addition of such fundamental features into an empirical experience, but rather it only adds a scientific taxonomization to one's sensible experience of the spatio-temporal raw data.

Concerning the second qualification, I take it that scientific experience implicitly contains both an object-sided and a subject-sided moment. By differentiating between "moments" I mean to both (a) acknowledge that an individual's experience is actually unified (one does not necessarily have distinct experiences of an object-sided world and a subject-sided world), and (b) retain the idea that different features of one's unified experience have distinct originative histories. Thus, some of the features of a scientific experience are "raw" (pre-taxonomic), and so are object-sided, and the other features of the same experience are superadded (post-taxonomic), and so are subject-sided. I identify the raw elements of scientific experience as existence and distinguishability. I identify the added features of scientific experience as concepts, laws, theories, and any other element that is found in one's conceptual scheme.

In order to make room for the construction of scientific experience demanded by Kuhnian idealism, I go on to explain how the object-sided and subject-sided features are related to human cognition. I first contend that the object-sided features are immediately and passively perceived through a cognitive act called *pure observation*. That there is such an act that communicates the exact features that I have identified is definitely not empirically demonstrable. That is, I do not attempt to show that Kant was wrong in taking spatio-temporality as a cognitive addition to empirical experience. Rather, while I see Kantianism to be a possible interpretation of empirical experience, I do not find it unreasonable to suppose an alternative model that allows extension and alteration to be real features of the object-sided world. If I am right, then my experience of these features (especially extension) object-sidedly grounds my scientific conception. This assumption is key towards evading the total-relativist worry. In any case, I cannot but admit that it is a postulate on my part.

In addition, I also suppose that there is but one object-sided world that communicates itself in this manner to distinct human individuals, and that all human individuals have the same mechanisms for receiving the data. Neither of these suppositions are empirically demonstrable. Thus, I do not deny that it is conceivable that one spatio-temporal object-sided world could communicate itself distinctly to distinct human individuals because they have unique capacities for receiving such data, or that there are multiple object-sided worlds that present themselves distinctly to different human individuals. I also admit that making the exact assumptions that I have made leads to interesting concerns that ought to be addressed by anyone seeking to ground a fully worked out Kuhnian idealist ontology. But I am only offering a starting point for such a project here, so I don't take up the obligation.

After linking scientific experience to the object-sided world via a purely passive act of cognition, and after showing that the data passively received is too vague to lead to any legitimately scientific knowledge, I explain how pure-observational experience becomes scientific. The transformation of the the raw data into scientific knowledge on my account originates in a second cognitive act, *conceptualization*. The primary aim of this mental process is to systematize one's immediate, object-sided experience. This process is entirely active from the standpoint of the cognizer, as it involves the production of the paradigmatic elements of scientific experience. Natural kinds, relations, and any other possible form of classification are born in conceptualization. However, though these elements of scientific experience are freely created, it is not the case that they are ultimately unrestrained by the raw data. That is, some attempts at conceptualization will simply fail to accommodate the raw data and, thus, ought to be treated as fundamentally unacceptable. Allowing the object-sided world to play a limiting role is

essential for the avoidance of the relativism charge via a solution to the tethering problem. My case for this is made in the closing paragraph of §4.II.B.

Now, it is worth noting here that not every complex act of scientifically experiencing nature involves a creative act of conceptualization. For if one had adopted a conceptual scheme (knowingly or unknowingly) at some prior point in time, then it is possible that, in a particular instance of empirical experience, that person would pass over the creative stage and go directly from pure observation to the third stage, which I call common observation. Common observation is the synthetic experience of the object-sided world under a specific conceptual scheme. I take this act to result in the creation of a world that is importantly distinct from the object-sided world as well as fundamentally distinct from those other subject-sided worlds that have been created under distinct conceptual schemes. Each of these distinctions is significant towards justifying the multi-world view of Kuhn. I defend the thesis in detail in §4.IV.

Finally, I end this chapter with a consideration of one significant responsive problem that arises on the basis of my explication of Kuhnian doctrine – that I have developed a view that is guilty of a commitment to the givenness myth. After describing the myth, I contend that my view is not prone to the sort of givenness assumptions that lead to the problem for traditional sense-datum theorists. However, I do not to deny any commitments to assumptions of givenness on the view I promote. In closing this section, I explain the sort of givenness assumption that I am committed to and I offer reasons why I do not find the commitments as uniquely problematic.

1.II.D Introduction to Chapters Five and Six

Once I have presented my solution to the Tethering Problem, I will have completed my response to the total-relativism worry and, thus, I will have completed my development of the Kuhnian epistemological incommensurability thesis. Hence, I then turn my focus towards the

application of the thesis to the specific disagreement between Aristotle and Newton concerning the existence of void. Chapters Five and Six contain a presentation of the Aristotelian and Newtonian positions, respectively. For the most part, these chapters are expository and explicative. Thus, the content of these chapters is fairly straightforward and there is no real need for an in depth summary of what is to come. However, I do think that it is worth explaining why I have chosen to consider the issue with respect to these two conceptualizations rather than to other (perhaps more recent) renditions of the problem. That will be the focus of this introductory sub-section.

Historically, Aristotle is among the most forceful advocates for an anti-void view. So it definitely makes a lot of sense to use his position as one relata of such a contrast. On the surface, then, it seems that it would make the most sense to contrast him with those to whom he is so passionately responding – the atomists. Unfortunately, we do not possess an original (pre-Aristotelian) and systematic presentation of atomistic doctrine. Hence, any detailed development of the paradigm underlying the atomistic position would remain speculative, perhaps even giving rise to many distinct interpretive possibilities. This would render the contrast between the opposing views, via the application of Kuhnian doctrine, as much more speculative as well. But I desire a more demonstrative, historically sound result than this. My worry is that, if I transcend the historical record in my contrast example, then I am no longer portraying incommensurability as a real historical phenomena. Rather, it becomes only a possible one. But I prefer the more empirical implication. Therefore, while I do describe the atomistic position in Chapter Five, as it is given us from the pen of Aristotle, and while I even attempt to give the view some empirical strength, I do this without an immediate concern for either (1) whether Aristotle has construed the atomist view as charitably as possible, and (2) how the atomists may have responded. In

short, my appeal to the atomistic view is made only for the sake of providing a satisfactory starting point for a consideration of Aristotle's rejection of the pro-void view; and it could not be developed much further than this without transcending the historical record.

But then perhaps I should have eschewed any discussion of Aristotle altogether and, thus, I should have focused on a pair of contrasting positions that we do have plenty of information about. For example, perhaps, I could have contrasted the positions of Maxwell and Michelson, or of Descartes and Newton. With regard to the former possibility, such a discussion would require a much more extensive treatment of mathematical formalization than I am presently interested in pursuing. The result of that inquiry would be too abstract for my tastes, especially at such an early stage of my larger project. The second option, therefore, would have been the much more appropriate of the two. In fact, I considered this option quite seriously, investing significant time studying Descartes and coming to understand his own pro-plenum view. And I think that it is certainly the case that a contrast could be made which fits the Kuhnian model that I propose in Chapters Two and Three. However, I decided not to use the Descartes v. Newton contrast for three reasons.

First, I did not use the Descartes v. Newton contrast because it was much more subtle than the contrast which can be made between Aristotle and Newton. And the aim of this portion of the project is primarily to provide a straightforward case study by which the Kuhnian incommensurability doctrine is easy to recognize. Therefore, I thought it better to opt for the more obvious, direct, and pervasive presentation.

Second, if I were to have used the Descartes v. Newton contrast as my example, then I suppose that I would have had to pay much more attention to the development of the doctrine of methodological incommensurability, in addition to attention paid to the development of the

doctrine of epistemological incommensurability, thereby focusing on both taxonomies and values, rather than solely on taxonomic concerns. And this would have made it necessary that the present work be expanded significantly. Nonetheless, it does seem that a continuance of this project, one aimed at the further and fuller development of the Kuhnian incommensurability thesis, would be very well served by a consideration of this more up-to-date rendition of the void-controversy. Thus, I could follow up my current Chapter Seven with an eight chapter explicating the doctrine of methodological incommensurability, a ninth chapter detailing the Cartesian view, and a tenth chapter showing how the Cartesian and Newtonian positions, from Chapters Six and Nine respectively, exemplify the deeper level of disagreement. But, of course, I did not take this route, and opted instead for the clearer, more schematic differentiation that could be made between Aristotle and Newton. In doing so, I relegated the Cartesian view to the same role that atomism had in the fifth chapter, that is, as a relatively underdeveloped contrasting position that has as its main purpose to help me explain the Newtonian view. But, historically, it must be understood that Cartesianism is capable of undergirding a well-reasoned response to Newtonianism that does not have the same object-sided weaknesses that are present in the Aristotelian view.

Third, and finally, the contrast between Aristotle and Newton provides a nice subsidiary implication – it gives me a nice example of how the ontology and theory of cognition that I developed in Chapter Four really does help my version of the Kuhnian incommensurability thesis to avoid the charge of relativism. This implication is expressed in great detail in Chapter Seven, and is summarized in the following sub-section.

For all these reasons, it is clear that the contrast between Aristotle and Newton best serve my immediate purposes. But even if my purposes were slightly different, and the appropriate

choice were less obvious, one could hardly be faulted for putting a pair of giants into context and attempting to show that they each have something valuable to say both to us and to one another. That is, there is a sense in which allowing them to go into a theoretical battle and, yet, allowing each to come out without having been completely toppled seems a fine result from the point of view of the historian. Perhaps this is not as desirable from the point of view of the scientist or the optimistic philosopher. But, then, perhaps this meta-disagreement is reducible to a disagreement of theoretic values, and so is not an empirically decidable problem. This is the kind of issue I had in mind when I discussed the possibilities for the applicability of my theory beyond the bounds of problems in empirical science (§1.I). I will not consider it any further here.

1.II.E Introduction to Chapter Seven

Chapter Seven contains a synthesis of the most significant information that is presented in Chapters Two through Six. The primary goal of the chapter is to show that the disagreement between Aristotle and Newton strongly exemplifies Kuhnian incommensurability in full force.

But before I defend this claim, I take the opportunity to pursue a sub-goal. That is, I show that the ontology developed in Chapter Four has enough force to prevent just any interpretation of nature from being satisfactory – it really can undercut total-relativism. Thus, the preliminary section of that chapter is a case-study that demonstrates the applicability of my non-total-relativist, non-antirealist, Kuhnian idealism. In order to accomplish this fundamental task, I show that some aspects of Aristotelian natural philosophy, aspects which all modern scientists and philosophers would be inclined to identify as objectively false, are proven unsustainable on my view of science. For example, the claim that the moon is not made of earthy substance but rather is constituted by pure aether is undoubtedly false according to my model. Unless my proposal could handle a case such as this, it is unlikely that it could evade the total-relativism worry.

After disrupting the Aristotelian approach with my ontology, I go on to show that the position has not ben entirely undercut by reminding the reader of one last argument that Aristotle offered against the existence of void – the claim that void is an incoherent notion to begin with. I call this the Incoherence Argument. This argument is first proposed in §5.II.E, but as it proves to be the last hope for Aristotle's conclusion, I expand significantly on it in §7.II.A. The primary aim of the expansion is to find the justificatory assumptions of the argument and to show them to be both generally reasonable as well as object-sidedly consistent. The most fundamental assumption involves Aristotle's understanding concerning the nature of place. Thus, I go on to analyze (i) what he takes to be the essential features of place, (ii) what he identifies place with, and (iii) what he takes to be the "exact nature" of place.

Next, I consider how Isaac Newton could respond to the Incoherence Argument. In this section, I simply show that Newton can be allowed to agree with Aristotle regarding (i) and (iii) above. However, I also show that it is quite clear that he does not agree with Aristotle concerning (ii) above. Fortunately for the Newtonian, it can be demonstrated that differing on (ii), and identifying place with the object proposed by Newton, the sensorium of God, proves to be enough to evade the charge of incoherence. With the conceptual problem undercut, I end this section with the contention that Newton's position, like Aristotle's, seems both inoffensive to reason as well as object-sidedly consistent.

Finally, I end Chapter Seven by showing that the primary disagreement between Aristotle and Newton hinges upon how either one would answer a pair of questions. The first question is "Can two extended beings occupy the exact same place?" The second is "Can something be extensionally limited by a non-mechanical being?" I show that the debate at this level is entrenched in either thinker's subject-sided moment of empirical experience. I determine this to

be so because the difference in responses exemplifies a difference in the linguistic decisions and dispositional tendencies concerning both the value of certain theoretic questions and the appropriateness of certain solutions to these questions. And since such features of scientific experience, as was explained in §2.I, are paradigmatically determined, and since the object-sided world does not help to resolve the issue (and offers no immediate hope towards such a resolution), it follows that Aristotle and Newton are locked in a state of incommensurability with respect to the question of void's existence.

CHAPTER TWO:
SCIENTIFIC INCOMMENSURABILITY

In this chapter, I present Thomas Kuhn's doctrine of incommensurability. The aim herein is twofold. First, I wish to identify Kuhn's mature teaching on the subject. Though his original position in *The Structure of Scientific Revolutions* (*SSR*)[1] is familiar to most philosophers, few are acquainted with his developmental works, especially those written during the final few years of his life.[2] And it was in these works that Kuhn finally developed the conceptual machinery that he thought was necessary in order to complete his view. Unfortunately, however, he was unable to complete the account prior to his death. This brings me to my second aim. In addition to presenting Kuhn's views, I want to establish a set of conceptual limits to which any development of the Kuhnian position is bound because, in later chapters, I hope to develop a plausible account of Kuhnian incommensurability that is consistent with his mature understanding of the doctrine.

I begin by identifying the nature of a Kuhnian *paradigm*. Just as Kuhn's understanding of "incommensurability" underwent a process of maturation, so did his understanding of this term; though he actually completed his reconceptualization of "paradigm" (in 1974). I start with this task because Kuhnian incommensurability is a relation that stands between paradigms. And it seems natural to think that possessing a prior understanding of the relata involved in a relation would be beneficial towards understanding the relation. Once I have completed an exposition of "paradigm," I go on to consider Kuhn's understanding of "incommensurability" in §2.II.

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[1]All references to *SSR* are from Thomas Kuhn, *The Structure of Scientific Revolutions*, 3rd Edition (Chicago: University of Chicago Press, 1996).

[2]While most philosophers are familiar with *Structure*, chances are that they do not quite understand it. That it has been misunderstood becomes evident when one considers the critical tradition that deals with Kuhn's presentation in that work. Such misunderstandings are what led to the continued development of the view. For a nice synopsis of the ways in which Kuhn had been misunderstood, see Fred D'Agostino, "Verballed? Incommensurability 50 Years On" in *Synthese* 191 (2014), 517-538.

Finally, I have chosen to give a historical-developmental account for each concept. I think that this method is best suited to gain an appreciation for Kuhn's final conceptualizations, which are not entirely free of ambiguity. Possessing an awareness of the issues that led to these reconceptualizations puts one in a better position to properly understand Kuhn's brilliance. Additionally, particularly with respect to his doctrine of "incommensurability," presenting the matters with a consideration of their historical development provides an occasion for me to introduce a set of serious problems that arose for Kuhn's account in *SSR*, problems that his later doctrine was supposed to alleviate. As is shown in the following chapter, the state of Kuhn's doctrine at the time of his death did not suggest clear solutions for all of its problems (as Kuhn openly admits). I hope to demonstrate that there is a way of wielding Kuhn's later understanding to help him resist the most serious criticisms. I attempt this in Chapters Three and Four.

2.I THOMAS KUHN'S CONCEPTION OF A "PARADIGM"

2.I.A "Paradigm" as Portrayed in *Structure*

While Kuhn's understanding of "paradigm" in *SSR* is complex, he offers the following simple characterization: paradigms are "universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners" (preface, *x*). These scientific achievements, as correctly identified in the *Oxford Dictionary of Philosophy*, are "a framework of concepts, results, and procedures."[3] They provide problems by establishing the context "within which subsequent work is structured."[4] Kuhn spends the rest of *SSR* cashing this out. I have identified what I take to be six primary features of paradigms as described in *SSR*. Paradigms are: (1) constraining, (2) widely accepted, (3) complex, (4) clarifiable, (5) seemingly

[3]"Paradigms" in *The Oxford Dictionary of Philosophy*.
[4]Ibid.

impermanent, and (6) dependent upon contingent circumstances. I discuss each of these aspects in turn.

2.I.A.1 Paradigms are Constraining

The most important feature of a paradigm with regard to theoretic matters is that it acts as a constraint on scientific inquiry. It does so in two fundamental ways. First, a paradigm is used to identify which questions are considered worthy of serious pursuit (*SSR* 109-10). The questions derive, in some manner, from a set of foundational criteria that are adopted by the members of a paradigmatic community. There are no universal principles that govern the appropriateness of the proposed foundational criteria. The criteria that do this restrictive work are mostly non-empirical. For example, under the Ptolemaic paradigm, a driving question was "How can the planetary motions be described using only circular orbits?" This particular question may have been considered as legitimate by some ancient thinkers because they envisioned only circular motions to be capable of an infinite and steady duration. Of course, maintaining a commitment to the infinite duration of planetary motion is not an empirically necessary inference (it is almost universally denied by contemporary astronomers who affirm Big Bang cosmology). Nor is it empirically necessary to infer that non-circular motion is unable to accommodate a doctrine of cosmic consistency for an eternal duration (the Steady-State Model of the universe found many reasonable proponents into the early twentieth century). While the Ptolemaic theory could not accommodate later empirical discoveries very well, it seems to have adequately accounted for the observational information possessed at the time. From this, one can infer that the Ptolemaic question was based upon philosophical commitments rather than "empirical facts."

Second, paradigms restrict the range of solutions that are considered as available options for the scientist (6, 39-40). Again, as was the case with the restrictions relating to the legitimacy

of the questions asked, there is no obvious set of rules to which such limitations must conform. This is made clear by historical study, where solutions unavailable under one paradigm are found to be championed under another. For example, most Ptolemaic astronomers were satisfied to allow a model of planetary motion which placed epicycles upon epicycles in the hope of giving further specification to the order of the heavens. Yet a Ptolemaic astronomer would not have allowed a solution that put the sun at the center of the solar system or made an appeal to any mysterious attractional forces. Such solutions were ruled out by paradigmatic definition. However, those following the Keplerian paradigm were pleased to adopt heliocentrism while scoffing at the use of epicyclical descriptions.

2.I.A.2 Paradigms are Widely Accepted

According to Kuhn, scientific communities transmit scientific paradigms through "textbooks, lectures, and laboratory exercises" (43), as well as through popular manuals and philosophical texts (136-37). The process of transmission eventually brings it about that a set of paradigmatic constraints are accepted throughout entire communities of scientific researchers. In pre-paradigmatic periods, a number of groups compete for popular supremacy, each maintaining its own set of "appropriate" questions and solutions. There is an atmosphere of unbreachable discord until one manages to gain control of the majority. Support for one theory or another is garnered through a number of sociological factors. In the right societal conditions a paradigmatic period is born.[5]

[5]That Kuhn is able to make such a distinction might seem to betray that he needs another constraining aspect to be involved in a *true* paradigm in order to explain what it is that determines the wide acceptance. However, at times he speaks of "more global paradigms" (43-44), so he likely intends "pre-paradigmatic" to mean something to the effect of a period of "less-universal-paradigm-propagation." Thus, it is a conventional rather than an epistemic designation.

2.I.A.3 Paradigms are Complex

Paradigms are also complex. Kuhn lists a number of elements which may be involved in a paradigm including: "law, theory, application, and instrumentation" (11), "a body of concepts, phenomena, and techniques" (13), and metaphysical commitments (109). However, a paradigm is not complex in the sense of being a mere compound of such elements. Rather, paradigms are holistic – one "cannot be fully reduced to logically atomic components which might function in its stead" (11).[6] Consider this example. Laws and theories are often inferred on the basis of experiment. But experiments are developed in accordance with the character and function of the instrumentation that is available to the scientist;[7] so instrumentation actually influences the character of the results. However, the instrumentation receives its character and function from its developer, who built it on the basis of a prior set of commitments with respect to which data is deemed to be relevant and how that data ought to be read (40-41).[8] And these commitments are themselves inferred/abstracted from observation and conceptualization of experienced phenomena, which itself is understood on the basis of still prior commitments. At this base level, the principles are often interdefined – so a change in one changes them all (and, of course, whatever follows from them).

Now, one may be tempted to proclaim that these observations and conceptualizations are themselves inferred/abstracted from the "facts of nature," thus grounding the entire chain. For example, one might say that an observation of the moon orbiting Earth is inferred/abstracted from the fact that the moon really is orbiting the earth. If this were so, there might be no need to

[6]An obvious question may arise at this point: Are paradigms holistic even about the meaning of the terms it uses? It would seem that, if they are, then relativism and the possibility for interparadigmatic communication are issues of concern. The short answer is yes, but only to a limited extent (because meaning itself is ambiguous between intensional and extensional). I address these matters in great detail when I discuss incommensurability below.

[7]The instrumentation is simply that technology whereby measurements (quantitative or qualitative) are made for comparison. Without such measurements there cannot be abstract formalizations.

[8]It is clear that, on a holistic picture of the scientific enterprise, questions can (and often do) arise regarding the justificational circularity of the process. This issue is not a concern for my presentation at this point.

postulate paradigms as fundamental elements of scientific development. But Kuhn does think that the postulation of paradigms is necessary and that they must be "prior to the various concepts, laws, theories, and points of view that may be abstracted from it" (11). He argues that history shows that what is counted as an "empirical fact" actually changes when a paradigm changes (77-78). For example, many Aristotelian astronomers took it as factual that the earth did not participate in any orbital motion. But after the establishment of a heliocentric paradigm, astronomers took it as factual that the earth participates in orbital motion. Now, most would think it unlikely that *the universe itself* changes whenever a scientific community changes its explanation of it (i.e., there is a way that the universe actually is and has been the whole time). Kuhn is among such thinkers. If this majority is correct, then there must be something else that has changed: *the way the universe is said (perhaps even seen) to be according to the scientific community*. So, Kuhn infers, the change of belief in such matters has less to do with the way the world is, and more to do with our manner of accessing it through a set of prior commitments that are thought to be adequate for describing the world as well as the way it behaves (103, 109). And what else would these prior commitments be but theories, laws, and concepts held prior to the experiences.[9] It is apparent that there is some circularity in play.

2.I.A.4 Paradigms are Clarifiable

Another feature of paradigms is that they are clarifiable, and in more than one way. First, they are able to be articulated as normal science progresses. "Like an accepted judicial decision in the common law, it is an object for further articulation and specification under new or more stringent conditions" (23). The reason that this is possible is that "the existence of a paradigm need not imply that any full set of rules [constraints on research] exists" (44). Second, paradigms

[9]It is worth noting that I do not require that these theories, laws, and concepts be highly explicated.

are clarifiable by emendation, which usually comes about in response to new observations (56).[10] Now, some emendations do not require serious revisions, and so I count them as clarifiable. However, there are others that do require significant revisions; the more persistent a problem, the more divergent articulations of the original paradigm there will be. In essence, the rules become blurred (82-83). These sorts of emendations often lead to radical "paradigm shifts."

2.I.A.5 Paradigms are Impermanent

The impermanency of paradigms is historically evident. Occasionally, the scientific community adopts a large-scale reinterpretation of experience all at once (128-29). Thus, the problems, instruments, canons of solution, and the entire network of fact and theory change in such circumstances (140-41). These are called "revolutions." Now, if particular paradigms are subject to total replacement, this tells us that they are to be identified as representational models of the world (11) rather than inherent features of (or facts found in) the world. Thus, that these models are in some sense mind-dependent seems clear. Therefore, paradigms should be valued primarily for their ability to represent the total experience of the scientific community (44-46). Kuhn goes even so far as to call them metaphors related to puzzle solving in normal science.

Another aspect that can be inferred from the fact of paradigm change is that alternative paradigms usually turn out to be irreconcilable (103). If they were not, an established scientific community would never undergo drastic paradigmatic changes, but would simply hold out for clarification, even if it meant exerting a great deal of patience. As Kuhn succinctly explains:

[10]It is true that new perceptions are understood through the current paradigm. However, this does not mean that they do not sometimes involve problems of coherence. For example, let's say that I hold an Aristotelian paradigm and believe that the planets are composed of a subtle matter that is incapable of manifesting a rough surface. Then I am exposed for the first time to a the image of a non-smooth planet as seen through a telescope. This creates an immediate coherence problem for my position. Now, in some circumstances, I may be able to maintain my original position and claim that something else is amiss (e.g., that the telescope causes the image to be distorted). But what if I have some other commitments that do not allow for an explanation of this sort – perhaps I am committed to the value of lenses for other observations I have made. The point is that circumstances are bound to arise upon the addition of new observations that require qualification of previously accepted paradigmatic elements.

"Within the new paradigm, old terms, concepts, and experiments fall into new relationships, one with the other. The inevitable result is what we must call, though the term is not quite right, a misunderstanding between the two competing schools" (149-150).

2.I.A.6 Paradigms are Dependent upon Contingent Circumstances

Finally, Kuhnian paradigms depend upon contingent circumstances: "an apparently arbitrary element, compounded of personal and historical accident, is always a formative ingredient of the beliefs espoused by a given scientific community at a given time" (3-4). As a result, logic and experiment alone are insufficient to arbitrate between paradigms and it is often impossible for one to accept a scientific argument without first granting the paradigm that underlies it (94-95). In fact, Kuhn goes so far as to hold that different paradigms result in the experience of different worlds:[11]

> In a sense that I am unable to explicate further, the proponents of competing paradigms practice their trades in different worlds…. Practicing in different worlds, the two groups of scientists see different things when they look from the same point in the same direction. Again, that is not to say that they can see anything they please. Both are looking at the world, and what they look at has not changed. But in some areas they see different things, and they see them in different relations one to the other. (150)

This concludes my presentation of Kuhn's account of the nature of paradigms as found in *SSR*. However, with the release of *SSR*, Kuhn opened himself up to significant criticisms, some of them immediately concerned with the ambiguity of this central notion. In §2.I.B, I present his developed account which aims at clarifying the concept.

[11]Clearly this makes evident a fundamental tension in the Kuhnian account. In one section he claims that the world doesn't change when the paradigm changes, and in another section he claims that paradigm change results in the transference into another world. This tension is explicated in detail in the following chapter, where I also attempt to explain how both can be accepted at the same time.

2.I.B Paradigms in Kuhn's Later Work

Kuhn's primary work of response to the challenges against his use of "paradigm" is "Second Thoughts on Paradigms" (ST).[12] In that work, he acknowledges that his reviewers are nearly unanimous in contending that there had been many senses in which "paradigm" was used (294). After admitting his analytic failure, he explains that there are two distinct senses in which the term was intended: "One sense of paradigm is 'global,' embracing all the shared commitments of a scientific group; the other isolates a particularly important sort of commitment and is thus a subset of the first" (ibid). In this section, I begin by characterizing the distinction. I then explain how the portrayal from *SSR* already seems to reflect it. I conclude that the original work was not inconsistent with the later presentation. Rather, the original was just unclear.

2.I.B.1 The Disciplinary Matrix

First, Kuhn renames the more global sense of paradigm "the disciplinary matrix." As he explains, it is "'disciplinary' because it is the common possession of the practitioners of a professional discipline; 'matrix' because it is composed of ordered elements of various sorts, each requiring further specification" (297). He goes on to explain that there are a number of such constituents, three of which are symbolic generalizations, models, and exemplars (ibid).

"Symbolic generalizations" are "those expressions, deployed without question by the group, which can readily be cast in some logical form…. They are the formal, or the readily formalizable, components of the disciplinary matrix" (ibid). These expressions were previously identified as laws.[13] Laws are obviously "deployed without question," and they are involved in

[12]Thomas Kuhn, "Second Thoughts on Paradigms," (1974). Reprinted in *The Essential Tension* (Chicago: The University of Chicago Press), 293-319. The in-text pagination in this subsection refers to this work.

[13]On p. 464, Kuhn explains "the power of a science increases with the number of symbolic generalizations its practitioners have at their disposal." This seems to be a very good description of the affects of laws. In addition, he

the constraining discussed earlier. Many laws are already formal (e.g., Newton's Second Law is formalized as $f = ma$).[14] Others are readily formalizable – which reflects the idea that paradigms are clarifiable – a fact also already accounted for in the original text. A law that is formalizable is only seen to be so in hindsight. For example, before the formal nature of gravity was identified, it was already accepted that it was a universal principle of sorts. Even Aristotle seems to have held this, though he construed it as the law that those objects constituted by the earthy element tend towards the center of the universe in a lawlike fashion. Today, we might think that quantum leaps are formalizable even if we do not yet possess an adequate formal representation of the process. In summary, there is nothing about the inclusion of symbolic generalizations which amounts to a shift in the original use of "paradigm" as I have identified it.

"Models" are those elements of the disciplinary matrix which "provide the group with preferred analogies or, when deeply held, with an ontology. At one extreme, they are heuristic…. At the other, they are the objects of metaphysical commitment." The following is an example of a model that provides a heuristic "preferred analogy." Imagine that I put two nails fifteen inches apart into a sheet of plywood. Now imagine that I cut a piece of string twenty inches long. I tie each end of the string to one of the nails. Then, I pull the string tight (away from the nails, but still on the sheet of plywood) as far as it can stretch. Next, I put a pencil in the fold of the string and I move it clockwise without letting the string lose any of its tautness, drawing on the board as I go. Once I arrive back at the original spot, I have drawn an ellipse. I can use this model as a description of a planetary orbit around the sun (on a Keplarian paradigm of course). One of the nails represents the sun. The other nail represents nothing, just the alternate foci which is thought

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emphasizes the distinction between laws and theories (which were previously spoken of under the same breath), which seems to support splitting them up in these first two subcategories.

[14]Hoyningen-Huene describes laws as the "fundamental equations of theories" in order to characterizer the type of law under consideration. See his *Reconstructing Scientific Revolutions: Thomas S. Kuhn's Philosophy of Science* (Chicago: University of Chicago Press, 1993), 145-146.

to have no objective referent in the solar system. The pencil tip is the planet and the line drawn is the orbit. Finally, the tension in the string is representative of the causal interplay between the sun's gravitational pull and the inertial motion of the planet. This scenario counts as a heuristic analogy for a number of reasons[15] – for example, because the second nail has no objective corollary or because there is no physical object that holds the planet in its orbit as is the case with the string that restricts the motion of the pencil tip. Yet the model still manages to give an account of the phenomena under consideration.

On the contrary, some models are not offered as mere heuristic devices, but are intended to be really representative of the phenomena under consideration. Ernest Rutherford's conception of atomic constitution is an example. He referred to the solar system as a model for the interplay between the nucleus of an atom and its electron(s). In his scenario, the sun represents the giant nucleus and the planet(s) represent the significantly smaller electron(s). Both scenarios involve multiple invisible forces at work to keep the smaller body/bodies in a more or less steady orbit around the central object.[16] Of course, there are a number of differences between these scenarios; but insofar as the model is appealed to in a general sense as portraying actual objects and actual forces as really representative of other actual objects and actual forces, it seems to be more than heuristic, perhaps even ontological. In the case where the model was said to be an ontological representation, a scientist would identify the atomic object as itself a micro-level "solar" system. In contrast, the contraption I envisioned in the previous paragraph would not be considered as a "solar" system in any sense.

Like symbolic generalizations, the two kinds of models appear to correspond with certain aspects of Kuhn's original doctrine as well. The heuristic preferred analogies play a role similar

[15]This is not, of course, to say that it is completely heuristic.
[16]Of course the electron scenario allows for level jumps that would be unimaginable on the solar system level, but this disanalogy does not make the model any less ontological, it just makes it an imperfect representation.

to that of theories in that they are partial explanatory postulates that do not necessarily correlate to the objective character of nature. And the ontological models are hardly distinguishable from the metaphysical commitments in that each is supposed to identify and characterize objects in the natural realm. By using the term "model," then, Kuhn reinforces his original idea that paradigms are impermanent and representational. Moreover, as such, it does not appear that there is anything here that is inconsistent with the original presentation.

2.I.B.2 Exemplars

Finally, there are "exemplars." These are the "concrete problem solutions, accepted by the group as, in a quite usual sense, paradigmatic" (298). According to Kuhn, this is the second "and more fundamental" sense of paradigm that was identified above. By making this the more fundamental notion, Kuhn opens the door for a scientific community to function even in the face of serious theoretical disagreement (e.g., when there are philosophical differences regarding ontology and cognition or differences regarding the appropriateness of one model over another). The exemplars are used to transmit a (commonly unanalyzed) set of methodological rules to potential new members of the scientific community.[17] In other words, exemplars are a community's standard for new-member-initiation. The primary ways in which exemplars are shared are: (i) ostensively,[18] (ii) through the completion of problem sets found in science textbooks, and (iii) through the successful completion of predetermined laboratory exercises. The idea behind the concrete problem solutions is to form methodological habits which are to be used when trying to solve real-world scientific problems (307-308). Exemplars can be identified with "body of concepts [and] phenomena," applications, techniques, and probably instrumentation.

[17] e.g., the appropriate use of concepts

[18] For example, the exemplar for identifying a duck might be one's experience of walking through the park with her teacher and having her attention directed towards various objects which are identified as either ducks or non-ducks.

Therefore, the addition of exemplars in Kuhn's later work does not seem to require one to think that the original and mature accounts are inconsistent.

2.II THOMAS KUHN'S DOCTRINE OF INCOMMENSURABILITY

The doctrine of incommensurability is, according to Kuhn, the "central innovation" of *SSR*.[19] It is also his most controversial thesis. Because of this, Kuhn expended a great deal of effort to develop the doctrine in the thirty years following the original publication of *SSR*, directly addressing the doctrine in more than a dozen articles between 1970 and 1993. In this section, I track the evolution of Kuhn's incommensurability thesis, explaining how its maturation was supposed to alleviate some pressing concerns that emerged following its inauguration.[20]

I begin with a description of the pre-*SSR* event that led Kuhn to begin thinking about the problems that would eventually lead to the writing of his magnum opus. On first pass, this may seem an odd place to start, particularly since no direct conceptualization of incommensurability is immediately identifiable in the account.[21] However, as will become apparent, it serves as an exemplary case study which I use to explicate some of the clarifications that Kuhn makes on his developmental journey. After this, I consider the slightly ambiguous presence of "incommensurability" as it appears in *SSR* and I identify a number of serious difficulties that threaten Kuhn's innovation. Then, I spotlight Kuhn's solutions to these problems in the ensuing

[19]Thomas Kuhn, "Afterwords" (1993), reprinted in *The Road Since Structure* (Chicago: The University of Chicago Press, 2000), 228.

[20]One could simply give an account of his mature view without first describing the original account. However, this might leave a reader who is familiar with *SSR* and not the mature account confused because at least one significant alteration does take place – and I do not want to *appear to be* leaving out something difficult.

[21]The conceptualization of incommensurability would only come years later, once Kuhn had been exposed to the work of a number of others – especially Ludwik Fleck. For an account of Kuhn's intellectual debts, see Paul Oberheim, "On the Historical Origins of the Contemporary Notion of Incommensurability: Paul Feyerabend's Assault on Conceptual Conservativism," in *Studies and History of Philosophy of Science* 36 (2005), 364-7, 372-3. For a more detailed picture of a number of substantial divergences of Kuhn from Fleck, see Nicola Mößner, "Thought Styles and Paradigms – A Comparative Study of Ludwik Fleck and Thomas S. Kuhn," in *Studies in History and Philosophy of Science* 42 (2011), 362-371.

decades and identify why Kuhn might have considered his answers to be adequate. Finally, I contend that the mature doctrine is, for the most part, consistent with the original conception.

2.II.A The Initial Motivation[22]

While a graduate student at Harvard in 1947, Kuhn was commissioned by James Conant to write a case study on the historical development of mechanics. As part of his research, he had to study the early systematicians on the subject, including Aristotle. But Kuhn soon became quite uncomfortable for, as he explains, "as I was reading him, Aristotle appeared not only ignorant of mechanics, but a dreadfully bad physical scientist as well. About motion, in particular, his writings seemed to me full of egregious errors, both of logic and observation."[23] Kuhn's was hardly a unique experience, which is why Aristotle is regularly castigated as a poor scientist.[24] What makes this event special, however, was Kuhn's reaction – he found it hard to accept that one championed for his logical and observational skills for the better part of two thousand years could have been so terribly wrong on exactly these counts. Hence, opting for a more charitable response, Kuhn set out to investigate the matter more closely.

In the following weeks, Kuhn began to treat his study of Aristotle as a search to uncover the consistency and ingenuity of the ancient mechanical system. He eventually uncovered two important places where he had misconstrued Aristotle. First, he realized that he was mistaken to

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[22]The story told here is adapted from the autobiographical sketch given by Kuhn in his article "What are Scientific Revolutions?" (1987), reprinted in *The Road Since Structure*, 15-20. Some (Bird 2002, Brown 2005) have taken Kuhn's early motivation to be something more philosophical, namely, to give a refutation of positivism. I see no such motivation for the early Kuhn. As he readily admits (see his autobiographical interview at the end of The *Road Since Structure*) his philosophical training was quite limited early on in his career. In support of my view, see also Oberheim and Hoyningen-Huene, "Incommensurability, Realism, and Meta-Incommensurability" in *Theoria* 12.3 (1997), 449. Nonetheless, later doctrinal modifications are essentially reactive to the philosophical climate of Kuhn's day. This is supported by Kuhn himself in his foreword to Hoyningen-Huene's *Reconstructing Scientific Revolutions: Thomas S. Kuhn's Philosophy of Science* (Chicago: University of Chicago Press, 1993), xii.

[23]Kuhn (1987), 16.

[24]For example, in his book, *The Sleepwalkers*, which is a highly influential popular level work aimed at characterizing the scientific revolution, Arthur Koestler presents Aristotle (as well as Plato) as having brought natural science "into disrepute and decay" (53).

read "motion" as "local movement" since Aristotle meant something more general by it, namely any kind of material change. Such a distinction would obviously have a drastic effect on what one would take to be the proper subject matter for a science of "motion." In the Aristotelian sense, motion would refer not only to the transference of an object from a point, A, to another point, B, but it would also include events such as the transition of the leaves on a tree from green to orange or the decomposition of a corpse. Thus, it is not surprising that Aristotle's scientific conceptualization of "motion" would seem strange if compared to a modern conceptualization; and, by necessity, it would be formulated very abstractly.[25] Without acknowledging such a divergence in meaning, it is no wonder that Aristotle's doctrine of motion made it seem that he had no idea what he was doing when writing on mechanics. Much of what he was talking about wasn't mechanics (in the modern sense) at all!

Of course, people had been well aware of this Aristotelian irregularity well before Kuhn came upon it. Many were satisfied to contend that Aristotle was simply not analytic enough in his rendering of nature so as to distinguish local motion as an object deserving of its own narrower field of inquiry. But Kuhn saw an intriguing problem with such a dismissal when he recognized that he had also misconstrued the way Aristotle understood the perceived relationship between matter and qualities. Kuhn had been reading Aristotle's work through the modern lens which identifies matter as the cause, or perhaps one of the causes, of the qualities exemplified by an object. Thus the color of a leaf is caused by its material constitution and the way that material light reflects off of it and into a particularly constituted material receptacle (whether an eye, or a camera lens, etc.). But Aristotle had an inverted understanding of the matter-quality relationship and treated qualitative forms as the *sole* causes of the qualitative features of a material object. He held that qualities are exemplified when qualitative forms are instantiated in a *causally inert*

[25]For example, Aristotelian motion is simply the actualization of what was previously in potential.

"substance" identified as prime matter.[26] Once again, it is not surprising that missing such a distinction would give rise to an interpretation that saddled Aristotle with making a host of inferential errors. Impressively, Kuhn was able to recognize a connection between these two doctrines. Since prime matter has no active power, but gets its active qualities by being united with a material form, and since local motion is construable as an active quality of matter, it would be necessary to treat local motion as an effect of a material form, and so to consider it under the same science as alteration, decomposition, and any other sort of material change.

At this point, incommensurability remains explicitly uncharacterized. We have a story only about how Kuhn came to recognize a pair of divergent beliefs about the nature of motion, one of which is built upon seemingly naïve beliefs in apparently occult substances, i.e., prime matter and material forms. Perhaps even Kuhn may have felt this way at this point in his career. I contend, however, that incommensurability is definitely part of this experience. At the close of §2.II, once Kuhn's developed understanding of the doctrine as been expounded, I explain why I think that this is so.

2.II.B Incommensurability in *SSR*

In *SSR* the word "incommensurable" and its derivatives appear infrequently. Sometimes an analogous term (e.g., irreconcilable, misunderstanding) is used to capture the concept, though these terms are just as scarce as "incommensurability." Thus, the immaturity of the doctrine is quite obvious to the careful reader. By the end of this section, I will have shown that, despite the immaturity of the account, the fundamentals of the mature conception of incommensurability are present. However, as I argue in II.C, there are significant weaknesses with the original construal.

[26]I use scare quotes here to acknowledge to the reader that prime matter is not a substance in the standard sense for Aristotle – it is not capable of existing on its own. Aristotle actually identified both prime matter and all forms as secondary substances. Nonetheless, it was construed as pure potentiality – only capable of receiving action.

The first explicit gesture at a doctrine of incommensurability comes one hundred pages into the work when Kuhn asserts "the differences between successive paradigms are both necessary and irreconcilable."[27] One should recall that, for Kuhn, a paradigm is constituted by a number of elements, three of which are symbolic generalizations (formal or readily formalizable rules or axioms), models (heuristic or metaphysical expressions), and exemplars (concrete problem solutions). The idea that successive paradigms necessarily differ follows from Kuhn's conception of normal science (the appropriate activity of scientists operating in a non-revolutionary period). Normal science operates on *the assumption of the truth* of a given paradigm and allows that paradigm to constrain scientific effort with respect to both the problems dealt with and the solutions allowed. There is no internal allowance for the rejection of a paradigm in normal scientific activity. The rejection of a paradigm only occurs when it has been considered unable to solve a central problem that *it has itself* generated. If an original paradigm were able to accomplish the task in a satisfactory manner, it would not be subject to rejection in the first place. A new paradigm is adopted only in virtue of its ability to solve such problems without any serious explanatory regression. As such, it is safe to infer that there *must have* been some fundamental difference between the old and the new paradigms. It is not so clear what Kuhn has in mind by "irreconcilable" here, but he does offer some clarification.

Kuhn gives us a bit more information when he first describes what it means to be "incommensurable." Here he is discussing the worldview changes (paradigm shifts) in science and he compares them to visual gestalt switches (e.g., the famous duck/rabbit drawing). Kuhn explains that, once a scientist undergoes such a change, "the world of his research will seem,

[27]Kuhn, *Structure*, 103. He does mention the term "incommensurable" much earlier in the work, but it does not come with a clear description.

here and there, incommensurable with the one he had inhabited before."[28] In other words, since something (most likely many things) from his rules and methods, conceptualizations, model examples, or research standards changes, necessarily his professional world is made anew. Further, a revolutionized scientist does not even consider going back to the way things were. For, according to Kuhn, her new world is full of hope. Her memory of the old world is to be identified with the solution(s) that was/were out of her reach. The final moments of her life in that world, being characterized by its restrictive limitation and her fruitless effort, are, for all practical purposes, all of the valuable history that remains.

Now, while this may be a nice poetic illustration of what happens to one who undergoes paradigmatic transformation, a cautious reader should realize that it still lacks a clear statement of how "incommensurability" is to be understood. But an explanation does come in Kuhn's most extensive treatment of the matter in *SSR*. He explains that the "incommensurability of the pre- and postrevolutionary normal-scientific traditions" is based upon the following considerations:

(a). The proponents of competing paradigms will often disagree about the list of problems that any candidate for paradigm must resolve. Their standards or their definitions of [a] science are not the same. (148)

(b). Since new paradigms are born from old ones, they ordinarily incorporate much of the vocabulary and apparatus, both conceptual and manipulative, that the traditional paradigm had previously employed. But they seldom employ these borrowed elements in quite the traditional way. Within the new paradigm, old terms, concepts, and experiments fall into new relationships, one with the other. The inevitable result is what we must call, though the term is not quite right, a misunderstanding between the two competing schools. (149)

(c). In a sense that I am unable to explicate further, the proponents of competing paradigms practice their trades in different worlds…. Practicing in different worlds, the two groups of scientists see different things when they look from the same point in the same direction. Again, that is not to say that they can see anything they please. Both are looking at the world, and what they look at has not changed. But in some areas they see different things, and they see them in different relations one to the other. That is why a law that cannot even be demonstrated to one group of scientists may occasionally seem

[28]Kuhn, *Structure*, 112.

> intuitively obvious to another. Equally, it is why, before they can hope to communicate fully, one group or the other must experience the conversion that we have been calling a paradigm shift. Just because it is a transition between incommensurables, the transition between competing paradigms cannot be made a step at a time, forced by logic and neutral experience. Like the gestalt switch, it must occur all at once (though not necessarily in an instant) or not at all. (150)

From these three points, Kuhn provides a slightly more accurate sense of what is driving his charge that competing scientific paradigms/traditions are incommensurable.

Regarding (a), it has already been shown that paradigms establish the problems to be solved, the methods to use in seeking a solution, and the kinds of solutions that are deemed acceptable. Because Kuhn sees this as culminating in a doctrine of incommensurability, it can also be inferred that he does not believe there to be *any* external method of arbitration when it comes to problem-method-solution selection.[29] In support of this claim, one might refer to past revolutionary periods and consider how a dialogue on such matters would look. Consider this fictional account occurring just prior to the Newtonian Revolution. Imagine that Newton, having just formulated his new view of planetary motion, wants to convince a Cartesian (on theoretical grounds) to align with him in rejecting the existence of a mechanical ethereal fluid that fills all of outer space.[30] He would first have to convince her that she should simply stop asking impetus-focused questions and allow appeals to actions-at-a-distance to be used as adequate solutions for puzzles relating to the motions of bodies. Such a request would likely have seemed a ludicrous proposal to a Cartesian since such recourse would have been inconsistent with a mechanistic view built upon a corpuscularian plenum. In fact, I find it hard to imagine any realistic scenario

[29]There do seem to be some acceptable internal measures of a paradigm – the values of the second sort (consistency, coherence, and ability to answer its own problems). But these are not characterized as external because they are often uniquely construed according to either (i) the paradigm that stands over them or (ii) the individual who applies them.

[30]While Newton was not averse to the presence of ether (it was a central constituent of nature on his view), his conception was not entirely like that of Descartes. I consider Newton's account in depth in Chapter 6 (§6.II.A).

in which a committed Cartesian would or even should agree to accept Newton's new worldview without significant auxiliary reasons for doing so.[31]

In (b), Kuhn offers a linguistic reason for promoting the incommensurability doctrine.[32] Simply put, he contends that using terms in different ways is sometimes sufficient to prevent the understanding of statements made under a competing paradigm. Presumably, the sorts of things that are misunderstood could make the competing view appear more reasonable to an opponent (supposing that clarification were provided). Such a circumstance has already been encountered in the account of Kuhn's difficulty to come to grips with the Aristotelian view of motion. At first, it may have seemed that the two positions were commensurable; this inclination underlies the approach to the problem which takes Aristotle's view as an unanalyzed forerunner to a modern understanding of mechanics. But when one considers that each view is grounded in divergent beliefs about the causal relation between matter and qualitative expression, it becomes apparent that the two positions are unable to be made consistent with one another.[33] Thus, how irreconcilability is understood as an important feature of Kuhn's incommensurability is now more clear. It entails an inability to unify a set of distinct conclusions since they rest on a more elementary incongruity.

Kuhn identifies (c) as the "most fundamental aspect of the incommensurability of competing paradigms." This passage serves as a more detailed exposition of the earlier claim that a scientist who endures a paradigm shift has entered into a different world. But, in this case,

[31]The sorts of reasons that the Newtonian might offer are the inconsistency of the Cartesian paradigm or the inability of the Cartesian paradigm to solve a set of problems that have arisen through it. But the Cartesian would likely be able to make certain modifications without rejecting her core principles on such matters. Appeal to external reasons, such as the simplicity of the Newtonian paradigm, or its ability to answer its own problems in a pleasing manner would most likely be insufficient for the Cartesian who is satisfied with her own system.

[32]I identify this as "linguistic" because the use of an identical term masks an ambiguity that prevents the appropriate distinctions between two notions to be recognized. In cases of scientific terminology, the ambiguity of the languages sometimes masks deep metaphysical differences as is the case in my example below.

[33]i.e., if modern physicists are right about their conception of matter, then Aristotle is wrong and vice versa.

Kuhn changes the situation slightly, asking the reader to contrast not the scientist with himself, but with a peer who is standing next to him. This is an important strengthening of the situation because it is now apparent that *the exact same stimuli* sometimes produce different scientific experiences for individuals with distinct paradigms. For example, when the leaf changes from green to orange in the fall, Aristotle sees the effect of a formal principle and Newton does not. However, Kuhn is quick to try and retain some semblance of objectivity as he does not allow that a given stimuli can produce just any phenomenal experience since the world itself is not said to change. The final clarification, the denial of a step-by-step transition between paradigms, is an implication of incommensurability rather than a motivation for the doctrine. According to Kuhn, such a shift has to be virtually instantaneous rather than a step at a time.

In summary, a review of *SSR* reveals that the Kuhnian notion of incommensurability has the following features: (i) it is a relational property that stands between paradigms, (ii) it signifies the existence of a set of unresolvable differences, (iii) these differences are at least partly a result of the fact that different paradigms employ different conceptual and linguistic structures, (iv) the proponents of different paradigms live in different worlds, and (v) while a transition from one world to another is possible, it must be an all-at-once conversion experience, not just a processional one.

2.II.C Problems for the *SSR* Account

Given the brevity of the treatment of "incommensurability" in *SSR*, it is not surprising to find that there seem to be a number of significant problems with the doctrine as it stood in 1962. In this sub-section, I identify and explain what appeared to be the most pressing problems for Kuhn's *SSR* presentation. In §2.II.D, I go on to explain how Kuhn attempted to avoid these problems in his later work.

2.II.C.1 The Inconsistency Problem

The first and most fundamental problem for Kuhn is the indictment that his method of argumentation is inconsistent with the conclusion that he draws.[34] For he claims that scientific theorists *inevitably* misunderstand the positions of their opponents. But, in order to make his case, he seems to rely on his own ability to take an interpretive high ground (while writing as a historian of science), and proceeds to identify what he considers to be significant differences between the paradigms involved in a number of revolutionary events. In short, in order to give evidence that divergent paradigms are unable to be understood by those who reject them, he presents his understanding of competing paradigms and describes the points of disagreement. Hilary Putnam expresses the concern well: "to tell us that Galileo had 'incommensurable' notions and then to go on and describe them at length is totally incoherent."[35] If Kuhn is to escape this obvious problem, he needs to explain how incommensurability can be retained while, at the same time, allowing for both historical comparisons and theoretic reconstructions.

2.II.C.2 The Developmental Problem

The second problem has to do with the way that Kuhn describes the acceptance of new paradigms as all-at-once conversion-like experiences. This appears incompatible with the actual historical accounts he uses since each of the model events took place over a long period of time (e.g., the Copernican revolution was not really thought complete until after the time of Kepler

[34]Gerald Doppelt names Dudley Shapere and Israel Scheffler as early proponents of this line of thinking ("Kuhn's Epistemological Relativism: An Interpretation and Defense" in *Inquiry* 21.1-4 (1978), 37.). Of course, there are others as well, for example Donald Davidson makes this claim in "On the Very Idea of a Conceptual Scheme" in *Proceedings and Addresses of the American Philosophical Association*, Vol. 47 (1973-1974) and Hilary Putnam does so in *Reason, Truth, and History* (Cambridge: Cambridge University Press, 1981). Doppelt proposed a solution to the problem, but it was not the solution which was later developed by Kuhn (Kuhn 1983a).
[35]Putnam, *Reason, Truth, and History*, 114-115.

and Galileo, some one-hundred years later).[36] Additionally, there are accounts of individuals who contend that they experienced gradual conversions from Newtonian to Einsteinian physics during the earlier parts of the twentieth century.[37] But, if Kuhn rescinds the all-at-once criterion, then it would seem that he would need to replace it with a step-by-step transformational account. And changes of this sort would not seem to involve incommensurability since a simple retracing of the steps taken would allow one to give an account of the successive changes that should be understandable by proponents on either side of a debate, thus leaving what would seem to be a real hope for theoretical reconciliation.

2.II.C.3 The Relativism Problem

The third problem concerns the allegation that Kuhn's view leads to relativism. Howard Sankey expresses that worry as follows: "If, in the absence of independent means of evaluating paradigms, a paradigm is to be assessed by standards dictated by the paradigm itself, such appraisal is relative to acceptance of [the] paradigm."[38] Kuhn clearly saw this charge coming in *SSR*. He tried to limit the damage with the qualification that one cannot simply "see anything they please." That is, Kuhn envisioned some external feature that independently limited the ways in which the world might be construed. Nonetheless, the conceptual machinery needed to accomplish the task is not apparent. If, in fact, no preferred procedure for problem-method-solution selection exists, and if it truly is the case that a paradigm may simply be impenetrable to one's opponent, then what is to prevent *just any* paradigm from working, even those that do not

[36]To be fair, Kuhn does make the qualification in the third quote above that paradigmatic change "must occur all at once (though not necessarily in an instant) or not at all." But how this qualification is understood is not clear at that point. Later I show that the unclarity is likely representative of what Kuhn takes to have been a relatively insignificant mistake.

[37]See Stephen Toulmin, "Does the Distinction Between Normal and Revolutionary Science Hold Water" in I. Lakatos and A. Musgrave (eds), *Criticism and the Growth of Knowledge* (1970: Cambridge, U.K.: Cambridge University Press), 43-44.

[38]Howard Sankey, "Kuhn's Changing Concept of Incommensurability" in *The British Journal for the Philosophy of Science*, 44.4 (Dec. 1993), 762.

appear even remotely possible to one who is on the outside looking in?[39] In other words, how can Kuhn maintain that there are a limited number of possibilities for the presentation of the world?

2.II.C.4 The Scientific Progress Problem

The final problem involves the notion of scientific progress. Kuhn needs to account for the idea of progressive accuracy in science – the idea that science as a whole has been moving nearer to the truth as it has developed. His account seems unable to sufficiently identify the nature of the advancement which occurs in periods of normal scientific activity. Progress is identified here as an addition to the storehouse of solved problems that arise within the context of a paradigm. But how does it account for the idea that a new paradigm is more representative of the real world than that of its predecessor? This matter is not as simple as adding to the storehouse of answered questions since, in many cases, old questions are altered or abandoned in virtue of the acceptance of a new paradigm. Nor can a general notion of representative accuracy work since Kuhn is committed to the claim that incompatible paradigms can each account for the appearance of the world, albeit in distinct ways. Of course, that scientists believe revolutions are progressive seems beyond question.[40] But without actually being able to measure paradigms against one another, it is unclear to what extent one can legitimately be identified as somehow truer than another. Hence, Kuhn needs to give an account of the common intuition that science is progressive, even through periods of dramatic change, in order to render his notion of incommensurability more palatable to a general audience.

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[39]One might be tempted to say that the ability to answer the old paradigm's questions better than the old paradigm could serve as this limiting force. But this will not do because the new paradigm may have the ability to do away with some of the old questions (and solutions) by internal fiat, and so does not necessarily need to answer those questions..

[40]i.e., we seem inclined to say that the heliocentric view is truer than the geocentric model.

2.II.D The Development of the Doctrine

As previously noted, Kuhn did not leave his doctrine of incommensurability in its primordial state. As he explains in his final published essay, "Efforts to understand and refine it have been my primary and increasingly obsessive concern for thirty years, during the last five of which I've made what I take to be a rapid series of significant breakthroughs."[41] As early as 1969 he began to fumble around with each of these problems.[42] By the early 80s, all of the conceptual groundwork for explaining his solution to each of the problems was established. By the early 90s, his refinement of the doctrine was nearly complete.

2.II.D.1 Solution to the Inconsistency Problem

Given the chronology of Kuhn's work on incommensurability, it seems obvious that the charge of inconsistency was the earliest problem that he felt obligated to address. Since he was committed to the possibility of historical comparison and reconstruction, not to mention theoretic communicability once these were accomplished, he would need to explain how such activities are not ruled out *a priori* by a doctrine of incommensurability. This project was undertaken in a series of seven articles written between 1970 and 1993.[43]

Kuhn's first step was to clarify what he had in mind by the word "incommensurable." He contends that his original use was meant to be analogous to the way that a mathematician uses the term when she is describing the length relationship between the hypotenuse of a right triangle

[41]"Afterwords," 228.
[42]This is the time period where he began publishing on these matters. Presumably, he began considering objections much closer to the original release of the work and the ensuing period of initial criticism.
[43]Six of the articles are reprinted in Thomas Kuhn, *The Road Since Structure* (Chicago: The University of Chicago Press, 2000). These articles are: "Reflections on My Critics" (1970a), "Theory Change as Structure Change: Comments on the Sneed Formalism" (1976), "Commensurability, Comparability, Communicability" (1983a), "Possible Worlds in the History of Science" (1986), "The Road Since Structure" (1990), and "Afterwords" (1993). The remaining article, "Objectivity, Value Judgment, and Theory Choice" (1973), was reprinted in Thomas Kuhn, *The Essential Tension* (Chicago: The University of Chicago Press, 1977). Citations follow the pagination in these volumes. I identify each reference by the year of the publication and page numbers.

and either of its sides.[44] The notion of incommensurability in such circumstances is not that the hypotenuse and either of the sides are unable to be measured *against* one another, but rather that they are unable to be measured *by* one another – i.e., that "there is no unit of length contained without residue an integral number of times in each member of the pair." The mathematician, of course, admits that there is a basic way of measuring that can be applied to a hypotenuse and a side and that the measures are, in principle, comparable to one another. Kuhn envisions the idea of incommensurability as applying to scientific theories in the same manner. However, instead of "no common measure," the relationship must be "no common language." Thus, one might describe scientific incommensurability not as the claim that sets of paradigmatically indexed propositions are unable to be uttered and compared in a single language,[45] but rather that some sentences are unable to be uttered by one speaking *from within* the context of an incompatible paradigm *without residue or loss*.

Now, in order to sustain his thesis, Kuhn must explain how such utterances are generally possible, and yet illicit in the context of an incompatible paradigm. His first point is to acknowledge that understanding utterances in the general sense is very difficult since no perfectly neutral observation language exists (1970, 161-162).[46] In its place, scientists throughout history have used a number of paradigmatically influenced observation languages, some parts of which map on to other paradigmatically determined observation languages nearly perfectly, and

[44]Kuhn discusses this in 1983a (33-36) and 1986 (60) and in the 1995 interview that stands at the end of *RSS* (298).
[45]See Davidson, "On the Very Idea of a Conceptual Scheme," 5-20. In this work, Davidson argues against Kuhn's doctrine on the grounds that his idea of incommensurability is to be identified with untranslatability (12). Such a characterization is not without some justification (see Kuhn's 1990 quotation below). But, I will show that Kuhn understands untranslatability in a distinctive way that frees him from Davidson's worry. For a direct critique of Davidson, see both Howard Sankey, "In Defense of Untranslatability," in *Australasian Journal of Philosophy* 68:1 (1990), 1-21, and Nathaniel Goldberg, "E Pluribus Unum: Arguments Against Conceptual Schemes and Empirical Content," in *Southern Journal of Philosophy* XLII (2004), 411-438.
[46]Michael Malone provides a Kuhnian justification for this rejection: "Attempts to analyze theoretical knowledge in science into two categories of elements, conceptual ones such as internal and bridge principles, and the factual ones they underwrite, will fail at the point of classifying the symbolic generalizations, models and exemplars that serve as paradigms" ("Kuhn Reconstructed: Incommensurability Without Relativism" in *Studies in History and Philosophy of Science* 24.1 (1993), 73).

other parts of which do not map on so well. When taken as a whole, no paradigm is able to map its languages onto another in a holistic and perfect way (for then there would really be just one paradigm). This follows from Kuhn's *no-overlap principal*.[47]

A significant consequence of this is that a full translation of certain propositions from one paradigm to another is impossible. In Kuhn's words, "incommensurability thus becomes a sort of untranslatability, localized to one or another area in which two lexical taxonomies differ" (1990, 93).[48] Paradoxically, however, he does not see this implication as barring the legitimacy of the work of translators (i.e., historians), for

> what incommensurability bars is not quite the activity of professional translators. Rather, it is a quasi-mechanical activity governed in full by a manual which specifies, as a function of context, which string in one language may, *salva veritate*, be substituted for a given string in the other. (1986, 60)

A couple of questions arise here. First, what is this activity of translators that is not translation? Second, what is the character of this manual? Kuhn's answer to the first question is given in the immediately ensuing paragraphs. His answer to the second question is laid out in detail towards the close of this sub-section.

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[47]The "no-overlap principal" specifically stated is that there can be no overlap of kind terms (a kind term is one that designates its members according to both exemplified characteristics and projectabilities – those expected reactions in a certain set of specified circumstances) in their referents unless these kind terms are related as species to genus (1990, 92; 1993, 230-231). However, the principal is important for Kuhn in virtue of its role in the comparison of paradigms: "To bridge the gap between communities would require adding to one lexicon a kind term that overlaps, shares a referent, with one that is already in place. It is the situation that the non-overlap principle precludes" (1990, 92-93). As such, my implicative explosion of the application here (from concepts to entire lexicons) seems perfectly consistent with Kuhn's own use of the term, even if he never specifically applied it in this way (though I think he alluded to just such an explosion when he writes that the "lack of structural homology is what makes these portions of the French and English vocabularies incommensurable." 1983b, 714). For professional corroboration, see Jeffery McDonough, "A 'Rosa Multiflora' by Any Other Name: Taxonomic Incommensurability and Scientific Kinds" in *Synthese* 136.3 (2003), 349-351. McDonough identifies Kuhn's description as the no-internal overlap principle and the one I have described as the no-external overlap principle. He contends that the latter, though never mentioned by Kuhn, is more fundamental to the notion of taxonomic incommensurability.

[48]Xiang Chen has a nice way of putting this "A foreign term is untranslatable not because we cannot find its referents in its linguistic context, but because we cannot find a native term with referents that do not overlap those of the foreign one." See Xiang Chen, "Thomas Kuhn's Latest Notion of Incommensurability" in *Journal for General Philosophy of Science*, 28.2 (1997), 262.

For Kuhn, the work of the translator is a two-step process. The second step is identified as translation proper. "Translation" involves representing a foreign text through a target language in such a way as to maintain, for the most part, an equivalence of meaning and truth-functionality (1983a, 38). This means that the activity must not involve a creative reinterpretation of the way that the *terms* of the originating language are understood, either ostensively or semantically, once translated into the target language (though referential expansion is permitted so long as it does not lead to a substantial falsification of the less mature characterization).[49] In addition, this activity does not allow for any conceptual transfer that involves either residue or loss.[50] Thus, Hoyningen-Huene summarizes Kuhn's thought nicely when he says "translation has to conserve the meaning of the text … *and also truth values and reference*" [emphasis mine].[51] Consider the following example. The proposition "the moon travels around the earth" is paradigmatically translatable from classical geocentricism into the Copernican paradigm. Each considers the earth to be the physical object under our feet and the moon to be a very close satellite of the earth that reflects the light of the sun at night. Thus, there is no referential distinction. Further, each understands "travel" locomotively and "around" geometrically. Thus, these words retain roughly the same senses. Finally, each paradigm entails the affirmation of the proposition. It makes no difference whether the modern heliocentrist also attaches a host of other properties to "moon" (e.g., denying the perfect circularity of its orbit, identifying it as an imperfect material body with

[49]This is important. While sentences are generally considered to be the basic units of meaning with respect to making designations of truth and falsity, terms are not without some meaningful content. As will be seen, it is the disagreement about the applicability of terms with respect to objects/events in the world (i.e., taxonomization) that stands at the foundation of paradigmatic incommensurability. Generally, such disagreement is not noticed until one starts making truth functional claims and it is recognized that different languages make different judgments about sentences that initially seem to be saying the same thing. Thus, with regard to discovery, sentences seem to be the locus of incommensurability. But in actuality, the truth-functional disparity is a function of taxonomic divergence.
[50]This will be understood more clearly as the account progresses.
[51]Paul Hoyningen-Huene, "Kuhn's Conception of Incommensurability" in *Studies in the History and Philosophy of Science*, 21.3 (1990), 488.

a rocky and crater-filled surface, or being a place where Neil Armstrong walked). The original statement is indifferent to whether these modern claims are also affirmed.

The first step of the translator's work can be identified as interpretation. "Interpretation" is the activity regularly done by historians or by people working historically (ibid., 38-39). The interpreting historian looks at a text and tries to make sense of it by evaluating what is known about the circumstances surrounding its production; she does not aim to understand it in light of a current historical context.[52] Sometimes interpretation is very easy. At other times a text may seem impenetrable, and a great deal of struggle is required in order to render it intelligible. In all cases, however, the translator forms a hypothesis of meaning with regard to the text. This process sometimes results in the discovery of a new (to the interpreter) language. Whether this occurs depends on whether a discovery is wholly translatable into the target language of the discoverer. This remains an open question at the moment that interpretation has concluded. The example I gave above implicitly assumes that an instance of interpretation had previously taken place; for making the thoughts of the geocentrist and heliocentrist intelligible is a necessary precondition for claiming that they understand the terms involved in a relevantly similar way. Now, while in some cases interpretation leads to translatability, this is not always the case.[53] Kuhn's encounter with Aristotle's theory of motion is certainly an example of interpretation. But in that case translation into the modern tongue is out of reach. Aristotle's paradigm, requires that one affirm

[52]Howard Sankey generalizes the specific notion that I (directly following Kuhn) am identifying as interpretation to understanding (Kuhn sometimes uses it this way as well; e.g., (1990), 91-92). By doing so, he is able to extend the description of language learning beyond the work of the historian and to give an account of the formation of a language by a child or the learning of secondary languages by the process of immersion. This is perfectly consistent with Kuhn's doctrine. I stick with the more specific rendering because I am not concerned to give a general account for these things, but rather to simply account for the problem for the historian. For more information on the distinction between understanding and translation, see Howard Sankey, "Incommensurability, Translation, and Understanding" in *The Philosophical Quarterly* 41.165 (Oct. 1991), 414-426

[53]As Sankey puts it in (1990), "To interpret an expression must be, quite simply, to understand what it means. And to understand an expression is not to translate it, nor is understanding restricted to what is expressed in a home language. Rather, to understand consists simply in knowing the meaning of an expression, whatever language it belongs to" (6).

the truth of the proposition, "A change of color is a motion." The modern understanding says that this statement is false. In order to accommodate the truth valuation of the moderns, Aristotle would either have to give up some of his beliefs about the passive nature of matter, which is a loss, or would have to adopt the modern understanding of matter as having its own active power, which would lead to residue. Thus, the Aristotelian language, because it is unable to fully map onto the modern language of mechanics, is not considered as translatable into that language.[54]

Kuhn's project is clearly more concerned with those instances of interpretation that are not capable of being translated into a specific target language. He contends that proponents of distinct paradigms are like native speakers of distinct languages and that full intercommunication between them requires a possibility for translation (1973, 338-339). In cases where incompatible paradigms are involved in addressing *a point for which the differences matter*,[55] full translation from one into the other will be impossible. When this is the case, intercommunication on these matters is beyond reach as well. Speakers with different paradigms often use most of their words in the same way, having only a few of the chief concepts being subtly distinct.[56] This leads them to make significantly distinct inferences regarding issues of central importance. Such distinctions can easily go unrecognized because the high percentage of overlap between the languages of the disagreeing scientists may mask the few areas where overlap is lacking. In such cases, dialogue often results in severe communication breakdown. Even in those cases where the differences are

[54]From this one can see that the primary difference between the likes of Davidson and Kuhn is that the former is concerned mostly with the content of a concept, which he sees as fully characterizable under any given linguistic apparatus, whereas the latter is concerned with the applicability of a concept, which he sees as uniquely characterizable depending on the linguistic apparatus (paradigm) in use.

[55]This is an important distinction. Some (e.g., Davidson, 1974) have mistakenly taken the untranslatability thesis to apply to the entirety of rival languages rather than in the more limited sense intended by Kuhn.

[56]The terms of concern are "taxonomic terms or kind terms, a widespread category that includes natural kinds, artefactual kinds, social kinds, and probably others. In English, the class is coextensive, or nearly so, with the terms that by themselves or within appropriate phrases can take the indefinite article" (1990, 92). Since being a kind term involves partly what a word means and partly what its user has in her head when she employs it, they may be distinguished in either way. Differences of the second sort are clearly harder to identify.

recognized, it is very difficult, if not practically impossible, to hold the statements of the distinct languages side-by-side for comparison.[57] The following quotations serve as a summary for all that has just been said:

> The claim that two theories are incommensurable is then the claim that there is no language, neutral or otherwise, into which both theories, conceived as sets of sentences, can be translated without residue or loss…. Only for a small subgroup of (usually interdefined) terms and for sentences containing them do problems of translatability arise. (1983a, 35-36)

> My claim has been that key statements of an older science, including some that would ordinarily be considered merely descriptive, cannot be rendered in the language of the later science and vice versa. (1983a, 54-55)

The preceding explanation was a response to the question "What exactly is this activity of a translator that is not translation?" Now, the "manual which specifies, as a function of context, which string in one language may, *salva veritate*, be substituted for a given string in the other" must be identified. In the earlier periods of Kuhn's development of this doctrine, he identified these as translation manuals.[58] Once he distinguished translation and interpretation, Kuhn began referring to it as a lexicon. A lexicons, he claims, is needed to understand the interrelatedness of terms *from within* a paradigm (1986, 58-9). It places a limit on the kinds of statements which can be made and theories which can be used by those who adhere to that paradigm. It is the linguistic representation of the disciplinary matrix (1990, 93-94). Every lexicon must be independently understood. Attempts at understanding the meaning of a statement formed on the basis of one lexicon according to the structure of another can induce confusion and interpretive error. Thus, in the Aristotelian case with which §2.II began, Kuhn would assert that there are two lexicons: an

[57]Notice that the logical possibility of holding statements side by side for comparison is not itself denied. This is evidence that Kuhn wished to avoid the sort of thesis Davidson attempts to saddle him with. This is deemed to be logically possible given an ideal enriched lexicon. See explanation below.

[58]Kuhn took this idea from Quine and, for a while, followed his understanding. But he eventually became uncomfortable with Quine's thesis that multiple translations are equally legitimate and replaced it with a thesis that multiple translations may be equally limited. For an explanation of this, see Sankey (1993), 767ff, especially n.11.

Aristotelian lexicon for mechanics^{A} and a modern lexicon for mechanics^{M}; and neither of these two lexicons could be understood through the other, particularly with regard to any topic which is related to the scientific conception of motion. His initial attempt to read the Aristotelian propositions with a modern lexicon is what led to his misrepresentation of Aristotle.

However, the Aristotelian and modern lexicons can be linguistically embodied side-by-side in an enriched lexicon,[59] that of Thomas Kuhn the historian (1986, 74-75).[60] At first glance, this may seem to generate a contradiction in the Kuhnian doctrine. For, how could Kuhn affirm that there is no neutral language into which theories can be translated while at the same time offering a doctrine of an enriched lexicon, which seems to be nothing other than a neutral language into which multiple lexicons can be interpreted? I think Kuhn can escape this apparent problem. To understand how this is possible, consider the following statement:

> Each of the lexicons combined for the historian's purposes embodies knowledge of nature, and the two sorts of knowledge are incompatible, cannot coherently describe the same world. Except under very special circumstances, like those of the historian at work, the price of combining them is incoherence in the description of phenomena to which either one might alone have been applied. Even the historian avoids incoherence only by being sure at all times which lexicon he is using and why. (ibid.)

Implicit in this quotation is a very important consideration regarding incommensurability, the relation of a lexicon to the objective world. The historian can intercommunicate with all parties only because she is methodologically unconcerned with committing to a single way in which to

[59]By "enriched" one should not imagine that Kuhn is appealing to the existence of a better lexicon. Rather, he has in mind here a new lexicon that has more extensive analytical power, insofar as it is able to accommodate a number of paradigmatic linguistic representations. But an enriched lexicon comes with an important sacrifice. This is addressed below. Sankey (1990 & 1991) uses a slightly different terminology to make this clear when he describes the enriched lexicon as a metalanguage that contains the paradigmatically determined sub-languages – the languages of theories (1990, 3). Of course, I do not think "metalanguage" should be equated with "natural language" in the sense of a fundamental language. Rather it is to be understood as a general linguistic framework. Sankey would disagree (see §3.III.B and my response in §3.III.C.2).

[60]Of course, Kuhn would allow that anyone working as a historian could do the same.

describe the world scientifically.[61] The scientist, or anyone using a paradigmatically determined lexicon for that matter, can never do this (as a scientist or paradigmatic proponent) because his profession demands that he be committed to the world being describable in a certain way. So the enrichment Kuhn speaks of is born through a sacrifice, an open unconcern for settling the issue of "empirical truth."[62] In other words, the embodiment spoken of above is not a translational act but an interpretive one since truth-functionality is not involved. Hence, there is no contradiction.

In a later work (1986), Kuhn compares the historian's activity to that of a metaphysician holding a number of possible worlds in mind at the same time knowing that, at most, only one of them could perfectly map onto the real world.[63] Knowing which of these (if any) fits perfectly is practically impossible because of the complexity of real-world-experience, the subtlety of the differences between possible worlds, and the lack of human omniscience. To commit one's self to just one of these possible worlds is to commit to a fragile position. Therefore, a careful historian treats scientific paradigms as possible world-structures, and the lexicon for each of the paradigms as a representative linguistic taxonomy suitable for a subset of all possible worlds, namely those for which it may be a consistent lexical representation.[64] The result of all of this is that the historian must be, in a sense, multilingual (1986, 76-77; 1990, 93; 1993, 228). And, as is the case for any multilingual, she must be aware of which language she or her interlocutor is

[61]This methodological unconcern only extends to the historian as she is doing historical work. She may be very concerned with giving an account of the world, and this may play out in a number of ways (e.g., after presenting two incommensurable views of the world, she may give reasons for accepting one over the other, though such judgments cannot be made without first committing to a set of overarching values and to their interpretation).

[62]Nathaniel Goldberg (2004, 430-431) explicitly endorses this inference. Xinli Wang, who describes the difference between different lexical communities in terms of the appropriation of a trivalent logic (sentences can be true, false, or uninterpretable) does too ("Taxonomy, Truth-Value Gaps and Incommensurability: A Reconstruction of Kuhn's Taxonomic Interpretation of Incommensurability" in *Studies in History and Philosophy of Science* 33 (2002), 465-485). My account adds that the enriched lexicon of the historian takes the sacrifice a step farther by denying her own access to a world of truths. In essence, the historical perspective assumes a principle of scientific nonvalence.

[63]These thoughts are repeated in an abbreviated form in Kuhn's oft referenced "Dubbing and Redubbing: The Vulnerability of Rigid Designation" in Savage, Conant, and Haugeland (eds.), *Scientific Theory: Minnesota Studies in the Philosophy of Science* 19 (Minneapolis, MN: University of Minnesota Press, 1990), 298-318.

[64]There is no requirement that a lexical taxonomy be complete. Thus, each one ranges over many possible worlds.

using at any given time. Failure to pay adequate attention to this results in communication breakdown.

In summary, Kuhn avoids the charge of inconsistency by (1) dividing the work of the translator into two separable parts, interpretation and translation, and (2) distinguishing the goals of the historian and the scientist according to these two translational acts. The historian must maintain unconcern for referential truth and to focus solely on interpretation (which terminates in the possession of an enriched lexicon). On the contrary, the scientist must be concerned for referential truth, and so is involved in translation proper. Thus, she can have no enriched lexicon while operating in that function.

2.II.D.2 Solution to the Developmental Problem

Kuhn was moved to make a concession on the basis of the developmental problem. First, he decided to localize the all-at-once gestalt switch metaphor to individuals rather than to entire scientific communities. As he has explains it, "treating groups or communities as though they were individuals-writ-large misrepresents the process of conceptual change. Communities do not have experiences, much less gestalt switches" (1986, 88). Second, he specifically identified gestalt-switches with *the historians* who are involved in interpretive work rather than with the actual scientists involved in the revolutionary epochs, for the historian researching these matters must undergo such transformations in order to capture the historical circumstances since the textbooks lead her astray by presenting a false history, i.e., a history reinterpreted through the

most recent lexicon (ibid., 87-88).[65] The degree to which the individual actors in the revolutionary drama experience shifts of this sort is thus left undetermined.[66]

However, the mature explanation of incommensurability in the terms of diverse lexicons actually alleviates the concern that was originally in play here anyway. Recall the problem as I originally stated it above (II.C.2.):

> [Step-by-step development] would not seem to involve incommensurability since a simple retracing of the steps taken would allow one to give an account of the successive changes that should be understandable by proponents on each side of a debate, thus leaving what would seem to be a real hope for reconciliation.

The lexical interpretation of incommensurability entails that the issue at hand is not an issue of *understanding*, but an issue of *paradigmatic compatibility*. "Dabbling in the psychology of perception" (as Malone puts it) is useless.[67] If, among the lexical changes, there is at least one that entails the rejection of a central element of the original paradigm, or at least a rejection of the way in which that element is to be applied, then there is no transitional possibility at all.[68] In short, the prior and posterior lexicons are truth-functionally distinct. In fact, a revolutionary scientist need not even recognize that his former and current views are incompatible; this is the

[65]The reason such a history is said to be false is that the process of conceptualization described did not actually occur. The original claims had a meaning that was wholly different from the reinterpreted meaning. Furthermore, that classical conceptualization also does not play the genetic role that is implied by its inclusion in modern texts.

[66] Ipek Demir gives an insightful account of an otherwise undiscussed distinction in Kuhn between the incommensurability of the actor and the incommensurability of the analyst (historian) in his "Incommensurabilities in the Work of Thomas Kuhn," in *Studies in History and Philosophy of Science* 39 (2008), 133-142. As Demir rightly points out, the earliest work of Kuhn focuses on both the actors (scientists) and the incommensurability that they experienced when trying to push forward their discipline's achievement through periods of internal conflict and the incommensurability that historians face when looking back at these same revolutionary epochs. Kuhn clearly saw this conflation as problematic as his work matured, and so he stopped talking about historical episodes between individual scientists in order to clarify what he saw as the issue of primary philosophical importance: how one ought to represent the rationality of rejected scientific programs of the past (as well as how one should recognize our own since it is likely that they, at some future point, will also join the heap of discarded systems of thought).

[67]Malone (1993), 73.

[68]In the first case, one may consider Kepler's rejection of epicycles altogether from his paradigm as the sort of rejection under concern. In the second case, one may appeal to the Aristotelian case again, pointing out that, in order for the modern explanation of motion to be accepted, the way that the concept of matter is applied must be rejected in favor of a new way.

discovery of the historian.[69] Hence, reconciliation is just as elusive as ever because competing lexicons do not overlap identical sets of possible worlds. In summary, through Kuhn's own words:

> Some symbols in the new strings attach to nature differently than do the corresponding symbols in the old, thus distinguishing between situations which, in the antecedently available vocabulary, were the same…. Each of the resulting lexicons then gives access to its own set of possible worlds, and the two sets are disjoint. Translations involving terms introduced with the altered laws are impossible. (1986, 74-75)

2.II.D.3 Solution to the Relativism Problem

Kuhn took the charge of relativism very seriously, addressing it in a number of post-*SSR* works spanning twenty-four years.[70] His earliest attempts to disarm the charge were not fully successful, though they did limit the degree to which his view could be taken to be relativistic, namely, by arguing that his theory does not entail a subjective relativism. After distinguishing between paradigms as possessed by individuals and paradigms as possessed by the scientific community, he claimed that only those of the second sort were of any serious scientific value (1969, 191-92; 1970b 290-91).[71] Thus, the scientific relativism entailed by his view would be a corporate variety, which has more restrictions than a subjective variety simply in virtue of being corporate. In other words, Kuhn outlaws by fiat free-for-all science. Now, while this does appear to involve a lesser degree of relativism, Kuhn was certainly not satisfied. Rather, he seems to have hoped for a position which was capable of shedding the label in a more extensive manner.

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[69]This, perhaps, is not a deep problem in fields where former theories still have instrumental value (e.g., Newtonian physics vs. quantum physics). In such circumstances, the old paradigm remains a subject worthy of careful study. However, such circumstances are rare in the history of science.

[70]This sub-section will consider the development of Kuhn's doctrine as found, in addition to many of the works mentioned earlier, in the following works: "Postscript" to the third edition of *SSR* (1969), two articles reprinted in *The Essential Tension*, "Logic of Discovery or Psychology of Research" (1970b), and "Second Thoughts on Paradigms" (1974), and an article reprinted in *The Road Since Structure*, "The Natural and Human Sciences" (1989). Once again, the pagination will follow that of the compilation volumes.

[71]At this point, one may challenge Kuhn by questioning whether or not there is such a thing as "the scientific community." This concern seems perfectly appropriate to me. However, I will not take this course because, as will be seen shortly, Kuhn did not hold to this solution for long and his alternative is consistent with a challenge like this.

But shedding the label entirely would prove to be challenging, for he sought to uphold a number of beliefs that seemed inseparable from a relativistic interpretation. For example, Kuhn asserts "there is no neutral algorithm for theory-choice, no systematic decision procedure which, properly applied, must lead each individual in the group to the same decision" (1969, 199-200). In addition, he identifies theories as "imaginative posits, invented in one piece for application to nature" (1970b, 279-80). The following quotation expresses the conflict quite well:

> Simplicity, precision, and congruence with the theories used in other specialties are all significant values for the scientists, but they do not all dictate the same choice nor will they all be applied in the same way. That being the case, it is also important that group unanimity [of professional scientists operating normally in a given field] be a paramount value, causing the group to minimize the occasions for conflict and to reunite quickly about a single set of rules for puzzle solving even at the price of subdividing the specialty or excluding a formerly productive member. (ibid., 290-91)

For Kuhn to shed the label entirely, he needed to explain how "group unanimity" is sufficient for evading the charge of relativism. This would be especially difficult because his entire thesis is built around the acknowledgement of the historical claim that group unanimity is limited, at best, to periods of normal science and that such periods proved to be susceptible to revolutionary abandonment. In other words, when one thinks of the whole of scientific history as Kuhn construes it, there is no group unanimity at all!

Not surprisingly, Kuhn gave up on this approach. In its place, he offered a defense which is more modest in one sense, but quite radical in another. He begins by returning to the claim that there is no pure observation language and argues from this that, by necessity, there are a number of ways in which the world can be construed:

> In the absence of a brute data vocabulary, any attempt to describe one set of practices in the conceptual vocabulary, the meaning system, used to express the other, can only do violence…. No more in the natural than in the human sciences is there some neutral, culture-independent, set of categories within which the population – whether of objects or of actions – can be described. (1989, 220)

Despite this natural necessity that the world be construable in a variety of ways, Kuhn goes on to contend that it nonetheless presents itself in such a way as to rule out a majority of ways that the world might have been understood to be; there is something about the presentation that precludes "just any" characterization. For example, supposing that a lexicon identifies "water" to be "a substance that causes wetness" and "fire" to be "a visible effect of combustion," some rendering of the world such that the proposition "on the earth, fire falls from the sky more often than water" is necessitated should be deemed as empirically unacceptable. In other words, there are a limited number of incomplete conceptions of the world that map onto the real thing. Therefore, so long as one maintains a construal that is able to be mapped onto the world in a relatively successful way, with no points of obvious irreconcilable divergence, one has satisfied a form of objectivity that is sufficient for avoiding the charge of subjective relativism.[72]

Of course, one may complain that this is still a relativistic conception of the world insofar as it does not preclude the belief that there is something in one's conceptualization of the world that does not come from the world itself, but from a constructed manual that sets the rules for the characterization of the world. Some have offered this challenge. I consider two distinct charges of this sort in the following chapter. In his defense, Kuhn would likely contend that *no scientific account which seeks to avoid the cognitive element could explain the actual history of scientific development, especially revolutionary periods*. If he is correct that a number of viable, yet taxonomically incommensurable paradigms can account for the observed world, then perhaps Kuhn has avoided as much relativism as might possibly be avoided.[73]

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[72]This "mapability" criterion should be considered as a criterion designating a family resemblance rather than as a specific rule that can be analytically designated. For the "relative success" of applicability will be based upon evaluations that themselves may be based upon paradigmatically dependent values.

[73]Malone (1993), borrowing from Davidson (1974), addresses the concern that "degrees of relativism" is a bothersome concept by citing a difference between claiming that statements from distinct paradigms are completely incomparable and claiming that statements cannot be completely compared (74). This distinction seems to capture the moderateness of Kuhn's relativism, if indeed one will chose to call it that.

2.II.D.4 Solution to the Scientific Progress Problem

This leaves us with a final problem to address, the charge that Kuhn has made scientific progress impossible. In a number of places in his later work, Kuhn asks his readers to imagine the development of the sciences as representable by a version of the evolutionary tree diagram.[74] The trunk would, presumably, exemplify the category "philosophy of nature" and would be able to sustain only a few general propositions accepted by all individual scientists throughout history. Propositions contained in this section of the tree may include, for example, "an external world exists" and "nature operates according to regularities" among other statements. These are preconditions for doing any scientific work. Inevitably, while all scientists accept propositions of this sort, they often disagree on how, exactly, the terms should be understood. Must a belief in an "external world" be taken as entailing a belief in a corporeal one? Must an object possess some metaphysical individuating property in order to be a thing, or can it be a mode of something that is more fundamental and still be considered as a distinct thing? Must the regularities be lawlike? If so, should the laws be construed as prescriptive or descriptive? Incompatible answers to such problems are possible. Therefore, schools of thought are formed that take general science in a host of different directions. Sometimes, they address many of the same questions and differ only slightly, thereby giving the appearance of a single project. Schools on this level are portrayed on the tree diagram by large branches that come immediately out of the trunk.

Each of these branches then leads to the production of new theories, definitions, etc. that are based upon the taxonomic decisions that the scientists operating within it had corporately made. But problems similar to those that occurred in the trunk stage develop here as well; new statements made in response to new problems for members involved in the research occurring in that branch also involve terms that get construed in different ways. Thus, more branching occurs

[74]The following description of the tree is my gloss on Kuhn's appeal to consider science in accordance with it.

and new sub-schools are formed. This process, theoretically, may continue indefinitely, hence making it logically possible that the number of competing schools operating simultaneously is unbounded. But, like the situation depicted by the evolutionary tree, some branches eventually die off.[75] Those that die off may either become extinct, or, perhaps, they are abandoned but retain the logical possibility of being revitalized (e.g., by enduring a new reconceptualization that hasn't been tried before or by the discovery of new data).[76] Historically, however, we see that theoretic revivification is quite rare.

One might conclude from all of this that Kuhn has compounded the problem, and that progress proves impossible. The number of paradigmatic options may grow consistently at an exponential rate while only a few of the most delicate branches become extinguished (if any at all). Kuhn appears to agree with this last point. However, when one combines this story with the possible worlds metaphor that was explained earlier, the situation is actually reversed. Consider this. The trunk allows for a potentially infinite number of possible worlds. Each branch entails a limitation on the number of possible worlds which are deemed construable and each sub-branch a further limitation. So long as any of the branches become extinct, progress, if it is defined as the limitation of the number of logically possible worlds that are also metaphysically possible, is guaranteed. Moreover, the history of science shows us that it is extremely uncommon for those branches that have been previously abandoned to be later revitalized. So one may treat the set of

[75]There are a number of circumstances that could lead to branches dying off. Perhaps they become incapable of being reasonably sustained given new empirical discoveries that they cannot accommodate (e.g., the thesis that the earth is tambourine/pillar shaped, as was believed by some of the Presocratic philosophers, is no longer sustainable). Or maybe they become considered by the scientific community as unworthy of continued attention, perhaps because they have become too "metaphysical" (as would be the case with Aristotle's theory of the heavenly bodies as Intelligences). One author proposes that some branches die off because they lose their ability to solve puzzles – their principles lead to conflicting inferential implications and so predict both the affirmative and the negative to some important question (Alex Davies, "Kuhn on Incommensurability and Theory Choice" in *Studies in History and Philosophy of Science* 44 (2013), 571-579). This may be related to my first reason above.

[76]This notion of revivification may seem to be inconsistent with the evolutionary analogy. However, I wonder whether there is any guarantee that a species which has undergone biological extinction is, in fact, unable to be revitalized through a new evolutionary program that happens to produce a remarkably similar result.

the "dead but not fully extinguished" branches, for all practical purposes, as if they were extinct. Admittedly, this is only based on inductive inference, but it corresponds well with the actual practice of science. Hence, the stock of possible worlds is significantly reduced even further. Therefore, progress, construed as a continual limitation of possible worlds acknowledged as expressible candidates for the way the world actually is, is guaranteed.[77] [78]

What's more, even in those cases where a community might retrace its steps, choosing a previously abandoned theory, it will have rejected the adequacy of all of those possible worlds that it was previously allowing through the prior paradigm, thus making it possible that such an outcome would be a wash in the terms of the total number of possible worlds deemed acceptable by the community at large. Therefore, it seems that, by all accounts, Kuhn can give *at least some* consistent story of progress, without also giving up either his doctrine of incommensurability or his reliance on the historical evidence regarding scientific practice. He sums this up quite nicely:

> I am increasingly persuaded that the limited range of possible partners for future intercourse is the essential precondition for what is known as progress in both biological development and the development of knowledge. When I suggested earlier that incommensurability, properly understood, could reveal the source of the cognitive bite and authority of the sciences, its role as an isolating mechanism was prerequisite to the topic I had principally in mind. (1990, 99)

2.II.E The Consistency of the Immature and Mature Conceptions

Before concluding this section, as an aside I would like to consider whether the mature version of the incommensurability doctrine involves a significant alteration of Kuhn's teaching,

[77]Wang has a nice way of expressing this: "Eventually, each lexicon may identify a highly limited set of possible worlds – the possible worlds that are both stipulatable and verifiable within the lexicon – and eventually a single world that the language community conceives as the actual world" (2002, 474).

[78]It has been noted by Brown that this understanding of "progress" is essentially a fallibilistic one, since at no point can a theorist suppose that the account they are using involves metaphysically accurate concepts, or something of that sort (Harold Brown, "Incommensurability Reconsidered" in *Studies in History and Philosophy of Science* 36 (2005), 166). But he goes on to explain that there is no other way: "Once we recognize that humanity did not begin its intellectual journey already possessing all the concepts and methodological tools that would ever be required, incommensurability becomes a requirement for progress" (167).

or whether it can be counted as simply an unpacked version of the 1962 *SSR* account.[79] I argue that it does not involve a significant alteration. To do this, I show that the updated account has all of the same primary features as the original account and that the adaptations involve disambiguation rather than alteration.

Recall that the original account was recognized to possess the following characteristics: (i) it is a relational property that stands between paradigms, (ii) it signifies the existence of a set of unresolvable professional differences, (iii) these differences are at least partly a result of the fact that paradigms employ diverse conceptual and linguistic structures, (iv) proponents of distinct paradigms live in different worlds, and (v) while a transition from one world to another is possible, it must be an instantaneous conversion experience, not a processional one. With regard to (i), the relational property is now construed as standing between lexicons, the linguistic representations of paradigms, rather than between paradigms properly speaking. But this is a disambiguation, not an alteration. There is also a limitation here involving Kuhn's localization of incommensurability to a few central concepts and the implications that follow from them. However, if one considers the sorts of examples that Kuhn uses throughout the entire thirty-year period of development, no instance of applying "incommensurability" in a non-localized way can be found. Thus, that aspect seems to be a disambiguation as well. Regarding (ii), "unresolvable" should not be taken in an absolute sense, for new data or professional fiat can both lead to professional resolution. But, from an explicitly taxonomic perspective, given an

[79]The revision thesis has been given lip service by Xiang Chen in his (1997). There, Chen describes Kuhn as having undergone a series of revisions which narrow the scope of the original position by (1) dropping the gestalt analogy, (2) retreating to a localized version of incommensurability, and (3) introducing a theory of kinds. Phillip Kitcher makes an argument for Kuhnian alteration which is essentially based upon the notion that the Kuhnian limitations significantly change the doctrine as well. ("Implications of Incommensurability" in *PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association*, 1982:2 (1983), 689-703). I contend here that while these are revisions, they are not substantive. With respect to Kitcher, Kuhn himself identified the error as one of mistakenly equating reference-fixing and interpretation ("Response to Commentaries" in *PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association*, 1982:2 (1983), 712).

established set of data, it is clear that the fact of unresolvability remains. Again, this seems to be a qualification, not an important alteration. To (iii), it is obvious that nothing has changed, though the centrality of the linguistic aspect has become much more apparent. Regarding (iv), the claim that those with different paradigms live in different worlds is maintained in those circumstances where the conceptual taxonomies fail to completely overlap with one another. Finally, (v) has been emended so that the immediacy criterion has been denied, but this does not seem to have caused any serious trouble for the rest of the view. In sum, the mature position can be identified as a moderate development rather than as a serious alteration.[80]

2.III CONCLUSION

With that, I have finished my presentation of Kuhn's account of incommensurability. While the mature account is much more capable of avoiding some fundamental difficulties than was the original, it is not without its own problems. Most of the contemporary discussion centers on two of the original problems construed in a more nuanced light: the relativism problem and the progress problem. I deal with the updated relativism problem in the following two chapters. I leave concerns regarding the updated progress problem for a later project.

[80]Given the title of his article "Kuhn's Changing Concept of Incommensurability" (1993), it may seem that Sankey would disagree with me. However, he contends that the changes are clarificatory in nature as well (772).

CHAPTER THREE:
IS KUHNIAN INCOMMENSURABILITY RELATIVISTIC?

It is now clear that Kuhn's mature doctrine of incommensurability registers significant improvement over the original construal in *SSR*. But it is not the case that the maturation of the doctrine has explicitly provided satisfying solutions to more advanced challenges concerning the original lines of criticism. While focus on some of the problems did fade, the attention to the relativism problem seems to have increased. In this chapter, after characterizing what I have in mind by "relativism," I address a pair of arguments related to the allegation that Kuhnian incommensurability is problematically relativistic – that (a) paradigms are not objectively constrained by anything external to them, and (b) a lack of constraint prevents the possibility for making objective comparisons between competing paradigms.[1] I first consider the argument that Kuhn adopts a brand of idealism that necessarily entails the problematic variety of relativism. This challenge corresponds with (b) above. In response, I concede Kuhn's idealism, but argue that his particular species of idealism does not entail the expressed form of relativism. After this, I go on to consider the distinct claim that Kuhnian doctrine is antirealist, and, thus, that it fails to provide an objective basis upon which one's paradigmatic construal of the natural world can be limited. This corresponds with (a) above. In response, I use a number of Kuhnian texts and the doctrine of idealism explicated in the first part of this chapter to undercut the antirealism claim.[2]

However, before moving on, I would like to make a pair of disclaimers. First, this chapter is not intended to serve as a conclusive, stand-alone rebuttal to the relativism charges considered

[1]Sankey has distinguished two kinds of relativism that Kuhn has been charged with: rationality relativism and ontological relativism. The former is relativism with respect to scientific progress and the latter is relativism with respect to one's ability to construe the world appropriately. I am here concerned only with the latter notion. See "Kuhn's Ontological Relativism," in *Science & Education* 9.1-2, (2000), 59-75.

[2]It is perhaps possible to try and make the case that antirealism does not lead to relativism. I do not attempt such a response. Thus, for the sake of argument, I provisionally grant that antirealism would be damning.

herein. Rather, I intend to provide only provisional solutions which, in turn, generate a serious new concern. I call this new concern *the Tethering Problem*. Thus, this chapter is both ground clearing and problematic. A response to the newly generated indictment is issued in Chapter Four. The second disclaimer that I would like to make is that I am now offering an interpretation that is based upon the foundation lain in Chapter Two. It is perhaps only one of many possible, yet distinct, interpretations of the Kuhnian theory that are consistent with the original foundation. Thus, as I use the qualifier "Kuhnian" throughout the remainder of the work, it ought to be read as if united to the indefinite article: "a Kuhnian" not "the Kuhnian."

3.I ON RELATIVISM IN GENERAL

Before explaining what I have in mind by "relativism," I would like to say something about my motivation for addressing the relativism charge(s) in the first place. Primarily, I would like to distinguish my effort to answer the relativism charge(s) from the distinct project of motivating a worry about scientific relativism. That is, I will not attempt to dissuade anyone who thinks that the conception of science as relativistic is in principle unproblematic. Such a person will likely take the project that I am undertaking here to be superfluous at best. Perhaps this is ultimately correct. However, I suspect that the vast majority of philosophers of science, including Kuhn and most of his commentators, would not hold such a view. Rather, most seemed to be worried to sustain some important level of objectivity that prohibits the individual from deciding for himself what scientific theory can be used to characterize the empirical data. In what follows, I show that Kuhn's incommensurability thesis does not prohibit him from upholding objectivity in this manner. Instead, I contend that there are many possible varieties of relativism, some of which entail that certain empirical statements are impermissible, given a linguistic context. The

relativism that I attribute to Kuhn which follows from his incommensurability thesis is of this sort. Thus, it should be clear that relativism simpliciter is not my target. Rather, a very specific sort of relativism, one that is implied under both lines of critique that I address in the remainder of this chapter, is my target.

To be more clear, I shall characterize "relativism" as a concept that is expressible via a degreed scale. For my purposes, I identify only four stops on the scale, but I see no reason that there may not be more, perhaps even infinitely many if it were possible to make distinctions that were appropriately fine-grained. The four that I identify consist of two endpoints and two mid-points. The endpoints are "total-non-relativism" and "total-relativism." Some varieties of the total-non-relativistic conception of science might include a very optimistic version of Aristotelianism or a non-representational form of logical positivism.[3] On such construals of science, it would be supposed that we have direct access to the world as it really is and that the correct scientific concepts are established for us by nature. That is, some of the terms that we use in science are basic to the world itself, and we can access them either by some sort of mechanical abstraction process (i.e., Aristotelianism) or by some intensive form of philosophical analysis (i.e., positivism). It is very clear that Kuhn is not a total-non-relativist, as I shall contend by the end of this section. Hence, I will not spend any additional effort expanding upon this stop on the relativism scale.

In complete opposition to the total-non-relativist position is the total-relativist position. An advocate for a total-relativist conception of science might include someone who is committed to a very pessimistic version of representational idealism. Such an individual might postulate something similar to a "world-in-itself" which is not directly accessible to us and will express

[3]I do not mean to suppose that most (or perhaps even any) Aristotelians or positivists are non-relativists of this sort. That is, I hope that the reader can agree on the minimal fact that there are possible interpretations of Aristotelianism and positivism that satisfy this conception, even if they are not preferred.

doubt that any attempt to conceptualize this world can be either truth-conducive or objective. In other words, neither our sensible experience nor our intellectual experience are disposed towards knowing the world as it is in itself or towards knowing the world in the "correct" way. Thus, there can be no objective science. It is my understanding that the arguments I consider in the rest of this chapter, the charges concerning idealism (§3.II) and antirealism (§3.III), inappropriately saddle Kuhn with a total-relativist conception of science. Hence, I spend the rest of the chapter (i) showing that the charges of Robert Nola (§3.II) and Howard Sankey (§3.III) do, in fact, paint Kuhn in this way, and (ii) arguing that it is not necessary to conceive of Kuhn as committed to such a position.

However, in arguing that Kuhn is not a total-relativist, I am not willing to accept that Kuhn should be construed as a total-non-relativist. Rather, it is my belief that he occupies an intermediate position on the scale of relativism. In order to support this position, I offer here a pair of brief, conjectural arguments that Kuhnianism is not easily matched with either total-relativism or total-non-relativism. The arguments are based upon Kuhn's commitment to the real historical occurrence of scientific revolutions. These arguments are identified as conjectural insofar as I will not attempt to offer a significant defense for each the premises in the context of the present chapter. Rather, I only attempt to offer just enough explanation to make each premise fairly clear. The reason that I cannot provide much more than conjectural support here is that coming to a full understanding of the statements involved in this argument will depend upon first coming to understand my Kuhnian theory of cognition, which I develop in the following chapter. Unfortunately, I cannot adequately present that theory now without the groundwork that fills the rest of this chapter (i.e., the establishment of non-antirealist Kuhnian idealism). I encourage the reader to consider the arguments presented here only to grasp there general character for now,

but to withhold his or her final judgment until both the present and the following chapter have been adequately understood.

To begin, I contend that Kuhnianism is best construed as, to some degree, non-relativist. My argument is as follows.

(P1) If the process of scientific conceptualization were a total-relativistic one, then scientific conceptualization would be entirely formative of scientific experience.
(P2) If scientific conceptualization were entirely formative of scientific experience, then (for Kuhn)_revolutions should never happen.
(P3) But, according to Kuhn, revolutions do happen.
(C) Thus, the process of scientific conceptualization is not a total-relativistic one (for Kuhn).

By "scientific conceptualization," I have in mind the taxonomization of nature and the formation of both theories and laws for the purpose of explaining and/or predicting the workings of nature. By "scientific experience," I have in mind simply the end result of seeing the world through one's scientific conceptualization. Thus, when I adopt a heliocentric model of the solar system, I adopt a scientific conceptualization. And while my phenomenal experience of the sun is of its "rising" and "setting," my scientific experience of this event is perceived as an optical effect of the earth, upon which I stand, cycling around the sun. Hence, in (P1), I am simply pointing out that if the process conceptualization was *completely* up to me, then the experience that I have on the basis of of the application of my chosen system would be entirely up to me as well. In regard to (P2), I am taking for granted Kuhn's characterization of normal science as methodologically conservative. Thus, normal scientific activity aims to support and promote the paradigm which had previously been adopted. On the contrary, a revolution is a period of scientific history which involves the abandonment of a paradigm. Thus, it seems to me, if a paradigm is ever to be abandoned, given the principle of conservatism underlying normal science, then the only logical reason to do so would be the failure of the paradigm to correspond with scientific experience.

But if scientific experience is formed entirely on the basis of one's scientific conceptualization, such a circumstance should never come about. That is, the only way that the inconsistency could arise is for some additional factor to be involved in scientific conceptualization process. In (P3), I am just reaffirming the Kuhnian belief that revolutions have occurred. Hence, since (P3) is a rejection of the consequent of (P2), by modus tollens, the antecedent of (P2) must be rejected. And since the antecedent of (P2) is identical to the consequent of (P1), it likewise follows by modus tollens that the antecedent of (P1) must be rejected. Hence, (C).

Now, lest we assume that Kuhn commits himself to the position that Kuhnianism is non-relativistic, a parallel argument can be provided that prohibits the inference. The argument is:

(P1*) If the process of scientific conceptualization were a total-non-relativistic one, then nature would be entirely formative of scientific experience.
(P2*) If nature were entirely formative of scientific experience, then revolutions should never happen (according to Kuhn).
(P3*) But, according to Kuhn, revolutions do happen.
(C*) Therefore, the process of scientific conceptualization is not a total-non-relativistic one (for Kuhn).

The structure of this argument is identical to that above, thus given that Kuhn accepts the premises, the implication would follow for him here as well. In support of (P1*), I contend that by "total-non-relativistic" one should understand scientific conceptualization to be entirely a matter of empirical discovery. Thus, if scientific conceptualization occurred solely on the basis of empirical discovery, it would seem clear that the product of scientific conceptualization, scientific experience, would also be solely a product of empirical discovery. But if this were true, then it would seem that revolutions should never happen (unless of course *nature itself* was given to occasional wholesale alterations – a proposal which Kuhn adamantly rejects). Hence, since he is committed to the historical reality of scientific revolutions, (C*) will follow by way of a pair of modus tollens inferences. As such, we can clearly see that Kuhnianism is committed to the

rejection of both total-relativism and total-non-relativism with respect to scientific conceptualization. But, then, what are his alternatives?

Recall that I previously stated that there were at least four stops on the relativism scale, yet I have only identified the two endpoints until now. The other two stops that I have in mind, the midpoints, can be broadly identified as Kantianism and Kuhnianism. I distinguish these positions at some length in the following chapter (§4.I), so I will not give a full account of the distinction here. Instead, I will simply express how I understand each to function as an intermediate position. First, Kantianism is intermediate insofar as it is like total-non-relativism in that it takes there to be a natural ground of scientific conceptualization (i.e., the categorical structures of the mind) and like total-relativism in rejecting epistemic access to any world-in-itself (i.e., the noumenal world). On the other hand, my rendition of Kuhnianism is like total-non-relativism in supposing that human knowers do have access to the world-in-itself and is like total-relativism in denying that humans have any disposition towards scientific truth by the normal activity of conceptualization.[4] Putting aside any further development of these options, I now consider two arguments that Kuhnianism, at its core, is totally-relativistic.

3.II THE CHARGE CONCERNING IDEALISM

One serious charge against Kuhn's mature conception of incommensurability was issued by Robert Nola.[5] Nola's argument takes shape in three steps. First, he claims that the Kuhnian

[4]Since my primary objective in this portion of the project is to characterize Kuhnian incommensurability as not committed to total-relativism, I do not bother myself with the task of trying to determine which of these options turns out to be more or less relativistic. In fact, I am not sure that there is a right answer to this question as I can envision an argument in either direction.

[5]N.B. The article I am using was written thirteen years before Kuhn's mature conception was complete, so it was clearly not intended to be a direct challenge to Kuhn's final product. In fact, Nola does not cite anything after "Second Thoughts on Paradigms" (1974). Nonetheless, I take it that the criticism as proposed serves as a relevant challenge to Kuhn's final product, at least insofar as I have construed it. So I find it to be worthy of consideration

doctrine of incommensurability commits anyone who promotes it to a form of scientific idealism, the view that scientific terms do not actually refer to objects or events in the external world,[6] but rather, that they are, in some important sense, merely mind-dependent representations of such things.[7] After this, Nola identifies three varieties of scientific idealism, which I identify and explain in §3.II.A below. Finally, he contends that the Kuhnian variety of scientific idealism entails a radical form of relativism,[8] as opposed to the "less-radical" form entailed by the other varieties of idealism. I take Nola's "radical relativism" to be equivalent to what I have termed as "total-relativism." Thus, in summary, Nola paints a distinct picture of the Kuhnian thesis, in contrast to my claim above, by presenting Kuhnianism as having no epistemic access to a world in itself. Hence, unless Kuhn were Kantian, which I will show to be false in Chapter Four, Nola's understanding of Kuhn will be a total-relativistic one. In what follows, I begin by summarizing Nola's argument. I then give a partial defense of Kuhn against it, showing that the denial of epistemic access to the world in itself is not entailed by Kuhnianism..

In addition to rebutting a specific charge of relativism, the present discussion will prove to be valuable for another reason, primarily insofar as it provides an occasion to introduce a pair of doctrines *implied* by mature Kuhnian thought that I have not yet mentioned: Kuhnian idealism and a unique theory of reference that I think can be afforded in accordance with it. The Kuhnian

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here. Robert Nola, "'Paradigms Lost, or the World Regained' – An Excursion into Realism and Idealism in Science" in *Synthese* 45.3 (1980), 317-350.

[6]By external, I do not take Nola to necessitate a corporeal understanding of the world, but one where the world simply does not depend upon the human perceiver in question. Hence, scientific idealism is distinguished in general from immaterialism, dreaming, fictional storytelling, being a brain in a vat or the victim of an evil demon, etc. I often use just "idealism" but I intend the term to be understood strictly as scientific idealism throughout the project.

[7]I have taken Nola's understanding of idealism from his treatment on pp. 318-319 of "Paradigms Lost." In a later work, Nola identifies scientific realism as "an overarching empirical hypothesis which says that *most* of the unobservable posits of our current scientific theories exist in a mind-independent manner." See Robert Nola, "The Optimistic Meta-Induction and Ontological Continuity: The Case of the Electron," in *Rethinking Scientific Change and Theory Comparison: Stabilities, Ruptures, Incommensurabilities*, ed. by Soler, Hoyningen-Huene, and Sankey (Dordrecht, The Netherlands: Springer, 2009), 163.

[8]According to Nola, "radical relativism" is a "version of relativism in which not only can we not refer to the same theoretical entity from paradigm to paradigm (for example, the case of mass), but also we can not even refer to the same phenomenal data, or sensations, from paradigm to paradigm that would be available to the Berkeleyian" (332).

doctrine of idealism proves to be of instrumental importance for my response to the antirealism objection considered later in this chapter. It might also be useful towards buffering Kuhnian incommensurability from other possible charges of relativism that are not discussed in this work. Further, the explication of a Kuhnian theory of reference proves to be heuristically valuable, as it illuminates a need to identify an adequate ontological and cognitive substructure to support the objectivity of science under a Kuhnian construal.[9]

3.II.A Nola's Argument

Scientific idealism is set in contrast to the realist view of science, the view that scientific terms actually *refer* to objects or events in an external world. By "refer" one is to understand something more pervasive than a generic representation relation that stands between a term and an external object. Such relations can be accommodated by the scientific idealist. But, according to Nola, "reference" occurs only when the term used is able to put one "in touch with items in the world."[10] I take this to underscore the belief that a referring term is, in some way, *recognized to be a real representation of the intrinsic character* of the external object which it is supposed to represent.[11] In other words, when a term refers, there is, at minimum, some sort of formal

[9]In §2.II.D.3 of the previous chapter, I mentioned that one criticism of Kuhn was concerned that his view leads to relativism because it involves some structuring principle that does not come from the world. I noted then that this is correct, but that his view can be elaborated in such a way that it avoids as much relativism as might be possible. I hope to show how he accomplishes this by characterizing the "objective ontological and cognitive substructure" that I mention here. But the effort is put off for the following chapter.

[10]Ibid., 320.

[11]I make this inference on the basis of Nola's identification of non-realist scientific concepts on page 320, which includes celestial spheres and phlogiston. It is clear that both of these terms are meant to be about some real features of the world (a component of air and an explanation of planetary motion, respectively). Nonetheless, they are said to not refer because they don't exist. On the contrary, I suppose that a realist could claim that other scientific terms, for example oxygen and gravitational force, are afforded an ability to refer because they really do exist. That is to say, the air that phlogiston theory was about did not actually have an element in it with the character of phlogiston, but it does have an element with the character of oxygen. And the motion of the planets is not really a result of celestial spheres, but really is a result of gravitational forces. For this understanding to hold, Nola must allow non-referring terms to remain representative (have an about-ness relation). Of course, this would make non-referring terms to be referential for merely intensional items rather than of external objects. I find it hard to imagine that he would not

identity between the conceptual and ontological content that is objectively recognizable.[12] Non-referring scientific terms, then, could still be representative of external objects, but not in such a way that they are known to correspond with the intrinsic character of those objects. Thus, it could be that either (a) they do not correspond to the intrinsic character of the objects, or (b) they correspond, but the ability of the term-user to verify the correspondence is lacking. It is likely that the representativeness of referring scientific terms could be construed in a variety of ways. Identifying these does not seem important for the discussion here, so I leave the nature of the formal identity underdetermined.

The first variety of idealism identified by Nola is *radical idealism*. On this view, scientific terms represent intensional items and do not refer to objects in the external world.[13] For example, the radical idealist denies that either "oxygen," "phlogiston," or any other scientific term, could ever refer to an external world object involved in a combustive event.[14] All of scientific experience for a radical idealist is idealistic – scientific construals can never *refer* to the external world.[15] Radical idealism, as characterized by Nola here, seems akin to either total-relativism or the intermediate position that I have attributed to Kuhn on my aforementioned

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accept this construal since denying the about-ness relation of these terms would make it hard to make sense of his commitment to the communicative value of such terms (their use seems to imply a referent of some sort).

[12]Thus, it is clear that Nola's understanding of a realist view of science seems to be equivalent to the total-non-relativist conception that I described earlier.

[13]Throughout Chapters Three and Four, I intend to use "item" when speaking about an intensional thing, "object" when speaking of an external thing, and "entity" when speaking of one of Kuhn's constructed things. "Thing" is used as a generic placeholder for either an object, an entity, or an item insofar as each is considered only to the extent that it is a distinguishable particular of some sort. Most of the time these attributions are made with respect to individuals in the substantial sense, but there is no clear reason to preclude the possibility that they are equally able to ascribe events or properties just as well. Finally, I restrict my use of "refer" to the technical sense. So, for example, when I discuss the relation between intensional items and the terms that denote them, I use the term "represent."

[14]Of course "combustive" is no less a scientific term than the others. But, for the sake of argument, let's assume that all scientific theorists grant the designation of "combustive" to the same events. The event-ness aspect is taken as primitive. A basic justification for this assumption can be inferred from the ontology I provide in the next chapter.

[15]By "scientific experience" I mean the activity of applying scientific terms to the external world. Thus, it is not the case that a radical scientific idealist is necessarily one who denies the reality of an external world nor of the utility of conceiving it in a scientific manner. She simply denies the connection of scientific terms to the world.

scale. There is some ambiguity on this matter at this point since the construal does not explicitly deny access to the world in itself even though reference to it is explicitly denied. It will be seen however, that Nola seems to have in mind something like the latter alternative, and thus that this position represents an intermediate position on the relativism scale. However, Nola will deny that this is Kuhn's position.

The second variation of idealism is called *less-radical idealism* (or weak idealism). On this view, "there is an earlier phase of science which does not [refer to objects] in the [external] world but a later phase of science which does, the later phase being the direct path to a completed or final science" (320). A less-radical idealist could deny that "phlogiston" refers (or has referred) to any object in the external world and yet affirm that either "oxygen" does or some other concept will (provided that humanity has enough time to discover it).[16] Thus, scientific experience for the less-radical idealist can be expected to start out as completely ideal. But, at some point, a referring scientific concept can be discovered and one's scientific experience can *become an experience of the real world as it really is*. Once this occurs, and until a final science has been discovered, this idealist's world of scientific experience is partially real and partially ideal. Insofar as it is real, the scientific terms refer to the external objects. Insofar as it is ideal, the scientific terms represent only intensional items. This version of idealism seems akin to an intermediate position as well, though one that I have not yet identified and which I will not develop any further (e.g., a fallibilistic rendering of Aristotelianism or positivism). On such a view, the appropriate scientific concepts are abstractable or rationally inferable, but there is some natural cognitive limitation that prevents this from being an easy project.

[16]It is conceivable that a less-radical idealist could claim that "phlogiston" could make a comeback as the referring conception. This possibility does not really matter for the point at issue.

Finally, the third kind of idealism is identified as *relative idealism*; this is the brand that Nola attributes to Kuhn. We will encounter Nola's argument for this attribution below. The view is directly characterized as follows:

> Relative idealism is like radical idealism in that none of the terms of our theories ever manage to refer to what is really in the [external] world, but different in that each paradigm is fitted out with its own world of entities relative to which the terms of the theory in the paradigm refer. (328)

So, for the relative idealist, scientific terms are not meant to refer to objects in the external world. Nor are they meant to simply represent intensional items. Rather they are meant to "refer" to constructed entities in a world that is experienced by a paradigmatically informed mind.[17] For the remainder of §3.II.A, when I use "refer" or one of its derivatives in this unique sense, I denote it with a subscript $_i$ for idealist (i.e., refer$_i$, reference$_i$, etc.). For example, the relative idealist claims that neither "oxygen" nor "phlogiston" refer to external-world-objects, yet "phlogiston" refers$_i$ to entities in some paradigmatically determined worlds and "oxygen" refers$_i$ to entities in other paradigmatically determined worlds.

Now, at least some degree of incommensurability is an essential implication of scientific idealism under its general characterization. Earlier, it was stipulated that *scientific* idealism requires acknowledgment that an external world of objects exists and that scientific terms are non-referentially representative of the objects and events in this world. Hence, when scientific disagreement comes about, the people involved are discussing the same individual objects or events in a fundamental sense. This is evidenced by the fact that contention over general designations of individuation (i.e., objects or events) are rare. Rather, scientific disagreements usually show concern for the relative appropriateness of the choice to apply one set of theoretical

[17]One should notice here the use of the term "refer" when describing the relationship between the scientific terms and the world of Kuhnian entities. This is proper insofar as the world under consideration here is at least partly an objective world for Kuhn. This is made clearer as I develop the doctrine and discuss the nature of this world below.

designations over another set of theoretical designations to *an agreed upon* stock of individuals or events.[18] More precisely, rivals disagree about which of the distinct intensional items more accurately represents the character of the objects or events which have previously been admitted to be residents of the external world. Unfortunately, insofar as these intensional items are not understood as *referring to* the external world, no immediately obvious method for evaluative comparison is apparent by which such conflicts can be resolved. Clearly, then, choosing between conflicting scientific conceptions solely on the basis of their relation to the external world would be an impossible decision to justify for any scientific idealist. And if decisive judgments are inaccessible, conflicting theories are equally maintainable. Hence the connection with incommensurability.[19]

So scientific idealism entails incommensurability. But scientific idealism does not entail *total* incommensurability unless its concepts and theories are *completely* unconstrained by the external world. And it is only total incommensurability that entails total-relativism. Thus, it is not at all surprising to find scientific idealists attempting to constrain their idealism. According to Nola, most of the proponents of scientific idealism attempt to avoid total incommensurability and its total-relativist implication by dividing scientific terms into two classes: the theoretical and the observational.[20] In doing so, these idealists attempt to identify a number of observational terms that disagreeing parties can (must?) agree upon. With a foundation of observational terms in place, one then attempts to establish the supremacy of her own view by demonstrating a more

[18]The exception being when the idealists involved are less-radical idealists who grant that one of party has come upon the referring term which is a constituent of the final science.

[19]One may wonder whether the idealist can avoid incommensurability by making the right qualifications. I respond that in order to qualify his way out of incommensurability, one qualifies himself into realism. This happens when the less-radical idealist qualifies his idealism so that it becomes capable of referring at some final stage.

[20]Some classic examples of theoretical terms are "electron" and "force." Some classical examples of observation terms are "blue" and "hard." However, these divisions have undergone a significant deal of scrutiny and are not easy to sustain. I have no interest in trying to defend the actual attempts to uphold such a division since I sincerely doubt that it can be done. It is enough to admit that, if such a distinction were really possible, then it would be sufficient to accomplish the goal discussed below.

extensive coherence between these terms and her theoretical approach. In other words, she tries to articulate that her theoretical terminology, when connected with the purportedly objective observational terminology, is best able to predict (to inferentially account for) the actual state of the observational data. If she is successful – if her coherence surpasses that which her opponent's explanation is capable of providing – then her opponent is supposed to change his allegiance to her theoretical framework. In short, the observational terms serve as a crucial tether between an idealist's intensional items and the external world; and so they undergird decisions about the preferability of competing frameworks.[21]

However, as Nola rightly infers, an appeal to the observational-theoretical distinction of scientific terms is beyond Kuhn's reach since Kuhn denies the reality of an observation language that "is free from some theoretical admixture in its meaning" (322). This commitment, contends Nola, entails a total "referential disparity between theories." For, if there is no ability to refer any of one's terms to an external world, then there is also no way to objectively measure competing theories against one another – each provides the measure of its own success. Nola denominates the disparity as *referential incommensurability* (323). I take this to be roughly synonymous with what I earlier identified as total incommensurability. Whatever we call it, given Kuhn's idealism, it seems obvious that total-relativism is a serious implicational threat.

Now, we know that Kuhn has expressed a desire to avoid total-relativism. Relatedly, he does not seem to want to support an instrumental reduction of the sciences – the view that the sciences are mere pragmatic activities with no actual concern for truth about the objective world. And we also know that he consistently refuses to adopt the theoretical-observational distinction between terms that other idealists regularly use to reestablish a referential connection between

[21]N.B. This move alone does not entail a solution to relativism simpliciter, but to the radical relativism described by Nola. It is still partly relativistic insofar as it precludes the ability to refer the theoretical items to real-world objects.

scientific terminology and external-world objects. So it is clear that some creative reconceptualization is needed in order to avoid the total-relativism charge. An appropriate first step could be to characterize the notion of reference$_i$ that is involved in relative idealism. In doing so, one might also be able to salvage a notion of truth broadly identified as external world correspondence.[22] According to Nola, Kuhn does attempt to establish a unique referential$_i$ mechanism that allows him to connect scientific terms with an external world. In what follows, I explain Nola's take on Kuhn's attempt. In doing so, I show that, if Nola's take is correct, then it is clear that Kuhn's view has a serious difficulty to address.

So Kuhn needs something external to which scientific terms may refer$_i$. But what might be available for him once he has eschewed the objective world as an option? To discover this, one must consider his idealism more closely. As is the case with each kind of scientific idealist, Kuhn distinguishes between the world-looked-at (i.e., the external world of the stimuli) and the world-seen (i.e., the world of ideal experience). I follow Hoyningen-Huene in designating these as the "object-sided world" and "subject-sided world."[23] Kuhn's referential$_i$ modification, according to Nola, is to *reconceive the way in which externality is predicated*. Whereas Kuhn agrees with other scientific idealists that the object-sided world is fitted with actual objects, capable in principle of being referred to, he disagrees about the status of things in a subject-sided world. Standard (non-relative) idealists describe the subject-sided world as being constituted by mere intensional items, items lacking externality, and thus items that are incapable of receiving

[22]In Kuhn's later work, he makes a series of charges against the correspondence theory of truth. Thus, it may seem that this path succeeds only on a misconstrual of Kuhn. However, I think I get Kuhn exactly right, even in light of his apparent denials of correspondence theory. For more information, see the discussion of this matter in §3.III.

[23]E.g., Paul Hoyningen-Huene, "Idealist Elements in Thomas Kuhn's Philosophy of Science" in *History of Philosophy Quarterly* 6:4 (1989), 393-401.

reference attribution.[24] But Kuhn, according to Nola, treats subject-sided worlds as capable of achieving reference$_i$, and so as constituted by entities and events that are external to the scientific perceiver.[25] And he does this without denying either the reality or the basic ontological fundamentality of the object-sided world.

In effect, Kuhn adopts a multi-world view that appears to sustain something like Kant's infamous noumenal/phenomenal world distinction.[26] In fact, the multi-world doctrine seems even more troublesome on the Kuhnian view than on the Kantian one; for at least Kant maintained that the categories of thought that give rise to the phenomenal world were uniform throughout humanity, thus limiting the number of phenomenal worlds that exist to just one. On the contrary, Kuhn's theory, since it implies that cognitive structures can differ, not only from person to person, but even from an earlier time to a later time for a single individual, entails that there exists a noumenal world as well as a number of phenomenal worlds.[27] In fact, historically there must have been more phenomenal worlds than there have been people.[28]

In summary, Kuhn's modified idealism systematically treats scientific terms as referring$_i$ to something external to a perceiver, though the entities referred$_i$ to are not themselves members of the object-sided world. In fact, there can be no other form of scientific reference$_i$ for Kuhn because all scientific conception is intimately related to one's paradigm, and so all scientific

[24]For radical idealists, no theoretical-scientific term ever refers to the object-sided world. Meanwhile, for less-radical idealists, only correct theoretical-scientific terms (those which actually demarcate features of objects in the external world) refer to the object-sided world. For neither side does reference to a subject-sided world arise.

[25]It is obvious that, if a Kuhnian theory of reference along these lines would be able to be maintained, then the character of the externality needs to be fleshed out. This is the project of the rest of this chapter as well as the next.

[26]This is not an entirely inappropriate connection to draw. However, I ask that the reader avoid making too strong a connection between the Kuhnian and the Kantian at this point. In the following chapter (§4.I), I show that the two construals are really distinct.

[27]I say "can differ" rather than "differs" for good reason. Kuhn's stated position does not openly adopt the claim that the subject-sided world, at least insofar as the scientist is concerned with it, is always different from individual-to-individual. Rather, he takes the subject-sided world, insofar as the scientist is concerned with it, to differ only from community-to-community except in rare cases.

[28]There are more phenomenal worlds in total, across the expanse of time. There is reason to believe that a person can only see the world through one paradigm at a given time, and thus the total number of subject-sided worlds would not be able to surpass the number of people in this way at any given moment.

conception is, by definition, subject-sided. This commitment conveniently allows Kuhn to retain a notion of scientific truth as the correspondence between scientific statements and the entities and events involved in one's paradigmatically influenced (subject-sided) experience. But it does this without establishing an ontological connection between scientific terminology and the object-sided world. So Kuhnian idealism purports to make it possible to have externally grounded scientific truth where no object-sided scientific facts are directly accessible to the scientist.[29] In contrast with standard idealisms, Kuhn's makes the possibility for identifying scientific truth to be significantly higher. Unfortunately, however, his solution achieves this only by allowing that, at least in some cases, a proposition and its apparent denial may each be true, albeit with regard to different paradigmatic frameworks.[30] This implication seems to substantiate the charge of total-relativism. As Nola explains:

> [Kuhn's] position seems like a more radical version of relativism in which not only can we not refer to the same theoretical entity from paradigm to paradigm … but also we cannot even refer to the same phenomenal data, or sensations, from paradigm to paradigm that would be available to the Berkeleyian. (332)

In other words, according to Nola's understanding of Kuhn, the world experienced by a Kuhnian scientist is up to the Kuhnian scientist. And this is exactly what we said would be the case if Kuhn were taken to be a total-relativist. Hence, it is clear that Nola thinks of Kuhn as, in fact, committed to total-relativism. Having shown this, I now offer a Kuhnian response.

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[29]This is not to say that there are not any facts at all. Keep in mind that scientific facts are only those that are the result of successfully referring scientific terms to the object-sided world. It is conceivable (as will be shown) that there are non-scientific object-sided facts that are accessible to the idealistic scientist.

[30]Or, in some cases, with reference to distinct perceivers who share the same paradigm. See Kuhn's discussion of a way in which fellow Newtonian's can come to disagree about the truth of a proposition on the mere basis of the order in which they are taught certain fundamental Newtonian propositions in "Dubbing and Redubbing: The Vulnerability of Rigid Designation," in Savage, Conant, and Haugeland (eds.), *Scientific Theory: Minnesota Studies in the Philosophy of Science* 19.(Minneapolis, MN: University of Minnesota Press, 1990.), 301-308. It should also be noted that the contradictoriness is actually only an appearance in most cases like this for Kuhn since terms will be understood differently, sometimes subtly, under distinct paradigms.

3.II.B A Kuhnian Response

To begin, I would like to affirm that much of what Nola says about the Kuhnian doctrine is correct. First, Kuhn does seem to endorse a version of idealism (hereafter Kuhnian idealism) insofar as he seems to maintain that scientific terminology does not refer to the object-sided world. Second, I agree that an idealist must find some sort of tether to the external world in order to avoid the total-relativism charge. Finally, I agree that Kuhn, because he has rejected the possibility of discovering a pure observation language, has relinquished his opportunity to use the distinction between theoretical and observation terms in order to connect the worlds. Therefore, if I am to rescue a Kuhnian variety of idealism from the serious charge of total-relativism, I need to establish the possibility that the subject-sided and object-sided worlds can be tethered in some other way.

I take two steps to accomplish this. First, I object to Nola's characterization of Kuhn's position as referentially incommensurable. I do so by challenging the claim that Kuhn is committed to the belief that there are multiple worlds existing at once in the sense relevant to the criticism. Instead, I offer an alternative understanding of Kuhn's notion of reference, one that has room for both reference and reference$_i$. In order to avoid terminological confusion, I provide a reworked denotation to characterize Kuhnian reference. I then argue that, since this construal is consistent with the received notion of reference, it is capable of avoiding total-relativism. This clears the way for my second step, which is to provide an account of a tether which is consistent with this theory of reference. I put this task aside until the subsequent chapter.

It is clear that Kuhn thinks that multiple worlds exist at once. This has been consistently maintained throughout his work, beginning with the statement that "proponents of competing paradigms practice their trades in different worlds" (*SSR*, 150), and reiterated in his final

published work, "Afterwords" (1993), by the rhetorical question: Is it then "inappropriate to say that the members of the two communities live in different worlds?" (233). However, it is also clear that Kuhn understands the object-sided world as having a special ontological status. This can be seen in that he takes the object-sided world to communicate a kind of constraining, raw data to those who encounter it: "two groups, the members of which have systematically different sensations *on receipt of the same stimuli* [emphasis mine], do *in some sense* live in different worlds."[31]

But, of course, Nola admits this. The problem is that he does not consider the possibility that having a duality of worlds might result in two species of reference (i.e., two ways to make contact between terms and external reality) – one for putting terms into contact with the object-sided world (previously: 'reference') and another for putting terms into contact with a subject-sided world (previously: 'reference$_i$'). In other words, Nola does not consider the possibility that Kuhn upholds a standard of referential adequacy that simultaneously retains the received view (external-world-correspondence) while also retaining a need for reference$_i$.[32] I contend that such a view is accessible to Kuhn and can be used to rescue him from the charge of total-relativism. Since Kuhn's view involves a synthesis of the two forms of reference, I find that it is helpful to present a new denotation, S-reference (for subject-sided reference) and O-reference (for object-sided reference).[33] This new designation is explained below.

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[31]Thomas Kuhn, "Postscript" (1969) in *The Structure of Scientific Revolutions*, 3rd Edition (Chicago: University of Chicago Press, 1996), 193.

[32]Later, I argue that the worlds are not external in the same sense. Thus the duality is not without qualification.

[33]One might wonder why I do not simply use S-reference and O-reference earlier instead of beginning with the reference/reference$_i$ designations. I think that the new Kuhnian distinction cuts along similar lines, but that it is qualitatively distinct from the distinction as characterized by Nola. In addition, the distinction between reference and reference$_i$ was born antithetically, and so may incline the reader to continue to associate them as alternatives, rather than as compatible notions of reference. But I seek to emphasize the coherence between the forms of reference. For these reasons, I find that distinguishing reference in both ways is appropriate.

But before explaining the position, I want to be clear that this account is not given with the aim of arguing that Kuhn's view is the right account of reference, nor even the best available. Rather, my aim is to present a Kuhnian account that is both logically inoffensive and capable of evading the total-relativism charge. On this account, S-reference and O-reference are similar insofar as each kind is intended to join a set of terms to experience via a correspondence relation. The two forms of reference are distinguished by two factors: (a) the terms that are said to refer, and (b) the objects that are said to be referred to.[34] [35] This new theory of reference involves the following four features:

(1) Subject-sided terms S-refer to entities in the subject-sided world.
(2) Object-sided terms O-refer to objects in the object-sided world.
(3) Subject-sided terms *cannot* S-refer to objects in the object-sided world.
(4) Object-sided terms *can* O-refer to entities in the subject-sided world.

It must be recognized that S-reference and O-reference are not distinguished by the nature of the act of reference in play, but rather by the sorts of terms that are involved in the act. In general, the act is the same in either case – some term is being "put in touch with" objects/entities (or activities) in some external world. As such, there is no need to identify new rules for S-referring or O-referring.

[34]One may wonder if I am not reintroducing a theoretical-observational distinction here in order to rescue Kuhn. I am not. The set of object-sided *scientific terms* is empty for Kuhn, and so it cannot function as a set of foundational terms to which one can turn in order to adjudicate disputes about theoretical construals of empirical experience. Whether there are such terms makes no difference, however, to whether or not a theoretical distinction between the two sorts of terms is possible and useful for further explication of a Kuhnian position. Alexander Bird offers another take on this very issue, arguing that a distinction between a semantic observational-theoretical distinction and an epistemological one can be made, and that Kuhn rejects only the former ("Kuhn, Nominalism, and Empiricism" in *Philosophy of Science* 70.4, (2003) 711-715); "There is no need to suppose that Kuhn's claims concerning the [observational/ theoretical] distinction do undermine the claim that there is a distinction between observational and theoretical propositions" (715). This explanation is consistent with what I propose here, though there is no reason to think that Bird would agree with me in my claim that the observational set will be devoid of scientific propositions.

[35]I do not deny the possibility that there are other important differences between subject-sided and object-sided reference. For example, the objectivity of an act of object-sided reference will transcend that of a subject-sided referential act. This is not important at this stage of the discussion. However, the acknowledgment of such potential differences explains why I have differentiated between S-refers and O-refers below.

With that in mind, features (1) and (2) express the possible forms of reference for Kuhn insofar as they identify two distinct (non-overlapping) classes of terms. (1) identifies the set of subject-sided terms and includes all terminology intended to convey information about the nature or essential properties of some thing or event. This includes all taxonomic terminology as well as those terms used to describe and/or substantiate taxonomic decisions. That these terms can refer to subject-sided entities is unproblematic given the idealist picture that has been established. On the other hand, (2) affirms the possibility of successfully referring a distinct set of terms to the object-sided world. Of course, we know that Kuhn adamantly denies this possibility with respect to scientific terminology. However, Kuhn is not committed to a denial of object-sided reference simpliciter. For example, given the ontological story that I develop in the next chapter, it is perfectly reasonable to think that Kuhn can refer to object-sided objects with specific nominal designations, aimed at identifying distinct objects, though not intended to identify any additional characteristics (such as the intrinsic properties) of these objects. Hence, the sorts of terms that O-refer are proper names and other terms meant to designate individuality. This denominating process is something like a Kripkean baptism by ostension.

Features (3) and (4) are stipulations involving the appropriateness, or lack thereof, of referring terms to the opposing kind of world – subject-sided terms to the object-sided world and object-sided terms to the subject-sided world. As is clear, I see a disparity in the possibility for cross-world reference here. First, feature (3) stipulates that subject-sided terms (including all properly scientific terms) are being inappropriately used if they are referred to the object-sided world. I establish this rule in order to accommodate the Kuhnian teaching that the object-sided world does not naturally communicate the true taxonomic structure to human observers, but rather that it only provides a basis for a variety of possible taxonomic construals. If subject-sided

terms are allowed to cross-over and refer to the object-sided world, then one must admit that the object-sided world provides epistemic access to its underlying structure, and thus, that choosing between paradigms is an objectively decidable endeavor. But Kuhnian doctrine straightforwardly denies this. So I must adopt (3) because it is demanded by the Kuhnian doctrine of paradigmatic incommensurability. Feature (4) stipulates that object-sided terms *can* appropriately be referred across worlds to the subject-sided realm. The reason for the difference here is twofold. First, Kuhnian doctrine is consistent with the belief that the object-sided world communicates data that can object-sidedly ground some instances of individuation. Second, the data can be used to account for the supposed limitations upon paradigm-building that has been alluded to a number of times already. As may be clear by now, the commitment to (4) is related to the establishment of an object-sided tether, which I have openly coveted.

The view of reference I propose here is not necessarily inconsistent with that favored by Nola. Nola and the Kuhnian can agree that reference occurs only when terms are associated with external objects. More importantly, they can agree that the general notion of reference should not be deflated in order to incorporate non-object-sided experience, for such deflationary tactics would result in an unfortunately weak conception of reference. The Kuhnian, however, differs in that he thinks that the general notion of reference must be *inflated* in order to assimilate the referential chasm that seems to lay between the two worlds of experience. I clarify this point with the following applicational example.

In the previous chapter, it was noted that "scientific motion" in Aristotle's physical world is thought to refer to a leaf's change of color. But Aristotle's physical world is not external in the object-sided sense, according to Kuhn. Why does Kuhn think this? Because the object-sided world cannot be uniquely accounted for by Aristotle's taxonomic explanation. Rather, Aristotle's

account lacks a determinate feature which guarantees that statements made under his scientific language will be more empirically adequate than those made under an incompatible, alternative language.[36] [37] Some empirical evidence for this claim is that an alternative taxonomic story *has* been told by Newtonians. In addition, rational support of a Humean kind can be given as well: for even if all scientists were to have agreed upon a particular taxonomic construal, this does not guarantee that the nature of the object-sided cause has been discovered. In short, there is nothing entailed in denoting a cause that demands that its effects will be qualitatively like it. So, supposing that an object-sided world really does bring about a certain describable experience in the observer, this does not guarantee that this observer *can refer scientific terms* to it object-sidedly. Now, if object-sided reference of scientific terms were naturally possible, this would admittedly set the standard for objectivity. Since it is not (for the Kuhnian) one must look elsewhere to substantiate objective reference. Fortunately, since subject-sided reference remains naturally possible (for the Kuhnian), a form of objectivity, namely, that of an interparadigmatic sort, is achievable. Of course, this admittedly falls short of the extraparadigmatic ideal.

So, from a Kuhnian perspective, all descriptions of scientific experience for which the identification of an object-sided taxonomy is indeterminate must be identified as subject-sided experiences. Therefore, the terms employed may only be said to refer subject-sidedly. A Kuhnian can, then, reject all attempts at cross-world scientific reference on the basis that *correspondence*

[36]Aristotle and his followers would contest this claim appealing to his infamous doctrine of abstraction. Other realists would appeal to some other process (e.g., Platonic direct perception) in order to ground the objectivity of their taxonomies. Suffice it to say that the appeal to such processes is hardly convincing as it is not at all clear that such processes actually occur, let alone whether human beings in fact have any actual faculty capable of doing such work. One would think that historical disagreement about both the intension and extension of class terms supplies evidence in Kuhn's favor (and, generally, in the favor of epistemological nominalism).

[37]Of course, lacking an object-sided taxonomic structure does not entail a total lack of facticity securing features. Non-taxonomic ones may be available, as I will contend in Chapter Four.

is not assured.[38] Therefore, far from it being the case that Kuhn's implied doctrine of reference is too loose, one can actually read him as supporting a very strict method by which one is allowed to refer terms to the world. For on the view presented here, all subject-sided scientific truth claims are instances of the correspondence between a lexically dependent proposition and the features of one's subject-sided experience. All object-sided scientific truth claims, if there were any, would be instances of correspondence between statements about the non-paradigmatically-determined features of scientific experience[39] and features of the object-sided world.[40]

3.II.C Concluding Remarks on the Charge Concerning Idealism

In summary, a Kuhnian view of reference need not be construed as essentially at odds with Nola's general notion of reference. Nor need it be considered conceptually problematic, so long as an ontological story can be told where the subject-sided/object-sided division can account for the character of empirical experience.[41] As such, there is nothing about my theory of reference itself that entails total-relativism. Therefore, for all practical purposes, the first part of

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[38]This claim is somewhat controversial even among Kuhnians. Some have taken Kuhn as holding that the object-sided world is simply not cut up according to genera and species (e.g., Ian Hacking, "Working in a New World: the Taxonomic Solution," in *World Changes*, ed. by Paul Horwich (1993), 275–310.). I do not follow this reading. Rather, I favor of a more modest one (along with Bird; 2003, 692-93). I think that Kuhn could grant that the world likely does have natural cuts, while maintaining that there is no natural cognitive capacity for identifying them. Nothing serious hangs on this disagreement with respect to Kuhn's doctrine of incommensurability though. All of the difference relates to how the system is developed beyond Kuhn. As I am now operating in the developmental stage, it seems that I have freedom to choose whichever reading best suits my aims.

[39]N.B. I have not yet discussed the existence of any such features, but Kuhn is committed to the existence of some, as will be seen. For now, it matters not whether there are in fact any such features. If there were not, there simply would be no such thing as object sided-reference. But even if this were the case, it would not entail that Kuhn's theory of reference is non-standard, it would only make him a pessimistic radical idealist.

[40]N.B. The theory of Kuhnian reference developed here seems to me to be satisfactory towards resolving the difficulty of understanding whether Kuhn was more concerned with 'internal' or 'external' reference (or whether he was, perhaps, an antireferentialist!). These concerns were raised in Alexander Bird, "Kuhn's Wrong Turning" in *Studies in History and Philosophy of Science* 33 (2002), 443-463. I am especially thinking about section 6. Nonetheless, sufficiently evading Bird's criticisms requires me to develop a special Kuhnian ontology as well (though Bird is not openly concerned with grounding so much as with how to spell out Kuhn's Kantian tendencies).

[41]This is not all that is needed to argue that the Kuhnian picture I have drawn is objectively plausible though. In order for it to be deemed acceptable as an actual live option for characterizing scientific experience, I will need to explain both why I think it reasonable to affirm the externality of subject-sided worlds and how I can differentiate the subject-sided and object-sided worlds through regular experience. These are the issues at hand in Chapter Four.

the path is clear for a Kuhnian to evade the relativism problem which is based upon Kuhnian idealism. Of course, it remains to be seen, whether or not this path is entirely traversable. I still need to give an explicit account of the tether that holds the subject-sided and object-sided worlds together, and this in a manner that is consistent with the Kuhnian theory of reference developed here. But, before we take that path, let us consider another argument that characterizes Kuhn as a total-relativist.

3.III THE CHARGE OF ANTIREALISM

Another serious charge against Kuhn's mature doctrine is that it entails antirealism (or, as some call it, ontological relativism[42]). As I understand it, antirealism seems to be a form of total-relativism, as I will explain shortly. Some, including one of Kuhn's more ardent defenders, Howard Sankey, believe that this claim is entirely justified on the basis of Kuhn's concessions.[43] In this section, I deny the charge and defend Kuhn. I begin by noting some Kuhnian assertions that seem to substantiate the charge. Then, I provide Sankey's criticism of Kuhn and his proposal for evading antirealism without giving up on taxonomic incommensurability. Unfortunately, Sankey's escape route is inaccessible to the Kuhnian idealist. Thus, I offer a two-part defense of the idealist version of Kuhnianism. First, I argue that the Kuhnian assertions that seem antirealist can be interpreted in a manor that is more favorable to Sankey's characterization of non-antirealism.[44] Then, I show that Sankey's concerns rest upon a serious mischaracterization of Kuhn's commitments.

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[42]Howard Sankey, *Rationality, Relativism, and Incommensurability* (Aldershot, England: Ashgate Publishing Ltd., 1997), 42ff.

[43]Sankey thinks Kuhn is wrong and argues that taxonomic incommensurability is consistent with scientific realism. See his "Taxonomic Incommensurability," in *International Studies in the Philosophy of Science* 12:1 (1998), 7-16. Others make the charge of antirealism against Kuhn as well (e.g., Hacking 1993, Bird 2003). Their arguments, though, do not supersede Sankey's in either content or clarity. That is why I have chosen him as my interlocutor.

[44]I use non-antirealism for good reason. This will be apparent by the end of the section.

3.III.A The Apparent Antirealism in Kuhn

Kuhn's three latest works, "The Road Since Structure" (1990), "The Trouble with the Historical Philosophy of Science" (1991) and "Afterwords" (1993), can be used to sanction a charge of antirealism.[45] But before considering the relevant texts from these works, we should identify Sankey's understanding of realism so we know how best to determine whether Kuhn is, in fact, antirealist.[46] Sankey provides four conditions for ontological realism:[47]

(I) *Anti-Instrumentalism*: "the unobservable entities postulated by scientific theories are conceived as real things, not mere predictive devices."
(II) *Truth-Directedness*: "the aim of science is to discover the truth about the world, and progress in science consists of advancing towards this aim."
(III) *Truth-as-Correspondence*: "what makes a statement true is that the world really is as the statement says it is."
(IV) *Metaphysical-Realism*: "scientists investigate an objective reality, whose existence, structure and properties are independent of human mental activity."

Of the four conditions of realism, the latter three appear to be seriously problematic for one who wishes, as I do, to defend Kuhn from the antirealism charge. But first, I quickly explain why I think Kuhn can easily avoid the first charge.

Kuhn's admittance of a distinction between the subject-sided and object-sided worlds can be understood as an attempt to avoid a commitment to instrumentalism. That is, since Kuhn is willing to take on a new set of challenging problems in order to affirm the externality of the subject-sided worlds of scientific experience, primarily so that he has something that scientific-concepts can refer to, then it seems that he has done more than enough to credit him with at least upholding the condition that the objects of scientific language are not merely predictive devices.

[45]I cite these works within the context of the text rather than by footnote. They will be designated according to original publication year. The pagination refers to the compilative work, *The Road Since Structure* (Chicago: The University of Chicago Press, 2000).
[46]By no means do I imagine that this is the only possible conception of realism (and thus, by implication, of antirealism). Nonetheless, this account of realism seems to adequately set itself against the description of antirealism that is found in *The Cambridge Dictionary of Philosophy*, where antirealism is a rejection of "the view that there are knowable mind independent facts, objects, or properties" (33). My Kuhnian account will involve the contention that some facts, objects, or properties of the object-sided world are known.
[47]Sankey, "Taxonomic Incommensurability," 15.

Therefore, I focus the majority of my attention on showing how he could also be said to uphold the latter three conditions. But first, I must show why it might seem that he does not.

Kuhn seems to deny the Truth-Directedness condition, that science is primarily aimed at the discovery of truths about the world. Instead, he takes puzzle-solving to be the chief scientific aim: "whether or not individual practitioners are aware of it, they are trained to and rewarded for solving intricate puzzles…. *No other goal is needed*" [emphasis mine] (1993, 251).[48] Not only is Kuhn entirely consistent in viewing puzzle solving as the primary objective of the scientist, but he also never openly identifies this activity with any aim of the scientist to establish truths about the object-sided world.[49] And there is good reason to think that he would not do such a thing; for, as we saw in the discussion of paradigms in the previous chapter, the formation of such puzzles is itself paradigmatically influenced, which means that these puzzles will be essentially related to the subject-sided world from the time of their initiation. Therefore, it is not unreasonable that Sankey infers that Kuhn is committed to a denial of the Truth-Directedness condition.

Likewise, Kuhn apparently rejects the Truth-as-Correspondence condition, that a true statement says something about the way the world really is. In fact, he seems to do so on a number of occasions. Consider the following passages:

> (1) The correspondence theory of truth, the notion that the goal, when evaluating scientific laws or theories, is to determine whether or not they correspond to an external, mind independent world … I'm persuaded must vanish together with foundationalism (1990, 95).[50]
> (2) If the notion of truth has a role to play in scientific development … then truth cannot be anything quite like the correspondence theory (1991, 115).
> (3) I begin with the question of science's zeroing in on … the truth. That claims to that effect are meaningless is a consequence of incommensurability (1993, 243-244).

[48]Ronald Giere, in an article where he is also trying to make the case that Kuhn is a realist of sorts, argues this exact point ("Kuhn as Perspectival Realist," in *Topoi* 32 (2013), 55). However, Giere does not try to get out of the problem as I will, but rather allows this to be a qualification on the sort of realism maintained by Kuhn. On the other hand, I think that qualifying Kuhn's realism also leads to a qualification in the way that this condition is understood, thus allowing a Kuhnian to accept it. Therefore, my response below can satisfactory overcome Giere's concerns.
[49]Alexander Bird argues from these grounds to Kuhn's antirealism (2003, 691-692).
[50]N.B. This statement also seems to support the denial of the Truth-Directedness condition above.

These passages seem to speak for themselves in supporting a Kuhnian denial of the Truth-as-Correspondence condition.

Finally, the Metaphysical-Realism condition, that scientists have the external world as their scientifically conceived object, does not seem to fare any better. For once we grant Kuhnian idealism and the related conception of reference discussed in §3.II.B, it seems to be apparent that entities considered scientifically cannot be construed as *really independent* of human cognitive activity. As Kuhn expresses the point, empirical facts are pliable, intertwined with existing belief and theory (1991, 107-108).

In addition to the incriminating textual case against Kuhn, Sankey presents two additional arguments that are suggested by Kuhn which connect incommensurability with the antirealism thesis. They are as follows:

A. *The Distinct-Entities Argument*: In the transition between theories, there is radical change in description of the entities postulated by theories, so that later theories refer to none of the entities to which earlier theories referred. Thus, the advance of science evidently does not yield an increase in truth about a common set of entities. (11-12)
B. *The Non-Evaluativity Argument*: Kuhn infers from untranslatability between a pair of theories that there is no sense in which one may be closer to the truth than the other … that there is no basis on which to judge that theories are closer to the truth. (12-13)

Clearly, the Metaphysical-Realism Condition in conjunction with the Distinct Entities Argument reflect Sankey's belief that Kuhn is best construed as a total-relativist. For, once again, the world-in-itself seems to be inaccessible to the scientist and the conceptual tools used to construct the world of experience are subject-sided in nature. Now, I have already given reason to reject this position in identifying Kuhnian Idealism in §2. However, it remains to be seen how Kuhnian idealism can be wielded as a response to the specific charge that Kuhn is antirealist. I take up this effort in §3.III.C.

3.III.B Sankey's Abandonment of Kuhn

It is unsurprising that Sankey, who wishes both to affirm taxonomic incommensurability and to avoid antirealism, attempts to simply abandon the letter of Kuhnian doctrine in order to get out from under the problem. Thus, his attempt at evading the problem does not involve any attempt to explain the Kuhnian statements more realistically. Instead, he simply attempts to respond to the apparent antirealist implications of taxonomic incommensurability as they are generated through the Distinct-Entities and Non-Evaluativity arguments. In this section, I recapitulate those responses.[51]

Sankey makes short work of the Distinct-Entities argument with an appeal to the causal theory of reference:[52]

> The force of this argument may be blunted, however, by means of a causal theory of reference: to the extent that reference is determined by a causal relationship between speaker and reality, it need not vary with change in description of the entities postulated by theories.

Sankey's response to the Non-Evaluativity argument, on the other hand, is more involved. First, he makes the general claim that "rival theories may make more or less true claims about the same entities, despite untranslatability." He then supports this with a series of three sub-points.

First, he argues that there is no reason to rule out the possibility of theoretic evaluation: "It is extremely implausible to suppose that conflicting theories *about the same domain* might be incapable *in principle* of being more or less true than one another." For, in granting that theories

[51]These responses are found in Sankey (1998), 12-13. Because they all occur over a mere two pages, I will not distract the reader with parenthetical citations.

[52]In an earlier essay, Sankey identifies this as the *causal descriptivism thesis*. The thesis can be summarized in three quotations from this earlier work: (I) "The reference of theoretical terms is determined by description of the causal mechanism, whereby the action of unobservable referents is thought to produce certain independently specified (e.g., by ostension) observable phenomena" (9). (II) "The content of theories may be compared by means of shared reference, despite translation failure due to semantic variance" (11). (III) "Translation may fail due to limits on reference determination within theories, yet the content of theories is comparable by means of reference" (p. 13). See Sankey's "Incommensurability: The Current State of Play," in *Theoria* 12 (1997), 425-445. My pagination refers to the version found at http://philpapers.org/rec/SANITC-2. See also his more recent "Scientific Realism and the Semantic Incommensurability Thesis" in *Studies in History and Philosophy of Science* 40 (2009), 196–202.

are about the same domain, one must also admit that there is some sort of referential similitude involved. This similitude, in turn, provides a possible ground on which to make these theoretic evaluations. To suppose that there is similitude without also acknowledging the mere possibility of such a ground seems unjustifiable.

Second, Sankey argues that once one grants the above point, one will have to also admit that taxonomic incommensurability is irrelevant to the question of whether theoretical evaluation is possible. For acknowledging referential similitude turns out to be all that is needed to make truth evaluation possible: "the inability to translate between theories does not entail that one theory may not be closer to the truth than another" since "truth depends on reference rather than sense." He goes on to explain that "such a possibility enables one theory to assert a greater number of truths about the shared set of things than the other does, so that it may approximate the truth more closely than the other." In short, once reference to an object-sided being has been agreed upon, all that is left to do is to count the number of truths that each of the paradigmatic expressions can account for with respect to this object. The paradigmatic expression that has the greater power of extending truth statements can be said to be a closer representation to nature than the other.

Third, Sankey argues that because Kuhn is committed to taxonomic incommensurability as a highly localized phenomenon – not only does it not extend to all terms used in scientific discourse, but it actually applies to a relatively small number of the terms involved – he must also accept the implication that there is overlap between rival paradigms such that truth claims can be made with respect to a significant number of objects. "There is no need to formulate propositions within the lexicon of a single theory in order to compare them for truth" since "the lexicon of a theory is the special vocabulary of a theory, which constitutes a local fragment of an

embracing natural language." Essentially, the very fact that a historian can build an enriched lexicon through which she can make sense of a great number of theories also allows her to make a great number of truth claims that can be used to distinguish the success of divergent theories. Therefore, "it is possible to compare the truth-content of incommensurable theories without translating between them."

3.III.C A Defense of Kuhn

At first glance, the evidence against Kuhn seems damning. Nonetheless, in what follows, I defend Kuhn against the charge that idealistic Kuhnianism entails antirealism. To accomplish this, I first explain how the supposed antirealist statements may be rendered so that each can be held alongside its related realist condition. Next, I show how acknowledging some basic qualifications can help Kuhn to escape the concerns implied by the Distinct-Entities argument without abandoning idealism. After this, I argue that the Non-Evaluativity argument, as stated, does not undermine Kuhnian doctrine either. Nonetheless, I reformulate the argument to make it more applicable. Once this has been done, I consider the response given by Sankey in light of the reformulation. In doing so, the important ways in which Sankey has missed the spirit of Kuhnian idealism and has mistaken it for an antirealist thesis can be easily recognized.

3.III.C.1 On Construing Kuhn as a Non-Antirealist

Kuhn clearly wanted to avoid being identified as antirealist. For one, he professes that his incommensurability thesis was developed in part "to defend notions like truth and knowledge from, for example, the excesses of postmodernist movements" (1990, 91). Insofar as antirealism is identifiable as a fundamental element of postmodernism,[53] this amounts to an implicit denial

[53]See "Postmodern" in *The Cambridge Dictionary of Philosophy*, 725.

of Kuhn's adherence to antirealism.[54] Additionally, Kuhn explicitly expresses dissatisfaction with having been as an labeled antirealist. In discussing "what Ernan [McMullin] takes to be my antirealist stance and my corresponding lack of concern for epistemic … values" Kuhn responds that the "characterization does not quite catch the nature of my enterprise" (1993, 243). Finally, Kuhn contends, "it is effability, not truth, that my view relativizes to worlds and practices" (1993, 249). In other words, the expressibility of truth, not its objectivity, is paradigmatically constrained on Kuhn's view. In general, missing this qualification makes him appear antirealist when it is not actually the case. Therefore, since Kuhn has a clear aversion to the connection of his views with antirealism, it only seems fair to attempt to interpret him as a realist of sorts.

That Kuhn wants to avoid antirealism is apparent. But this does not mean that he can. Of course, I think that he can be interpreted as a non-antirealist if one takes seriously two features of his thought: (1) the relationship of the enriched lexicon (metalanguage) to truth, and (2) the special nature of Kuhnian idealism described earlier.[55] In doing so, a consistency between Kuhn's problematic statements and the restrictive conditions for realism proposed by Sankey can be recognized.

Recall Sankey's Truth-Directedness condition, "the aim of science is to discover the truth about the world, and progress in science consists of advancing towards this aim." I see two ways in which the Kuhnian can incorporate this statement into his theoretical system. Both involve the identification of a distinction. First, the Kuhnian can distinguish the scientific activity that Kuhn had in mind when he made claim that problem-solving is the chief end of the scientist from the

[54]Of course, it's not an explicit denial; it may be possible to develop a non-postmodern conception of antirealism.
[55]Sankey is well aware of the idealist defense of Kuhn on these points. He rejects it because he believes that a construal of reality along Kantian or neo-Kantian terms, which is the manner in which Hoyningen-Huene and others (including myself) construe him, is incoherent (see 2009a). I indirectly address this incoherence charge in the next chapter. For now, one may interpret my response here as provisional upon the success of overcoming those charges (supposing that it overcomes the immediate difficulties as well of course!).

scientific activity that Sankey has in mind when he identifies the condition that the scientist be directed at truth. Second, the Kuhnian can distinguish between an overarching aim and a recognized aim.

First, the Kuhnian can distinguish between the scientific activities involved in scientific practice. His statement identifying problem solving as the aim of science may be meant to identify the aim of an individual scientist and not the aim of science itself. Science itself, the locally and temporally unrestricted collective activity of scientists, can be said to have a different aim, namely, the discovery of truth. There is no clear reason to think that these aims are inconsistent, and so cannot coexist.[56] From the perspective of the individual scientist, truth-discovery is is actually more of a meta-aim, one that transcends her *recognized* aims. While she may actually be directed towards the general aim of science, identifying empirical truth, she is not immediately concerned with this as she engages in scientific activity. Her attention is focused on other tasks, either on the formation of new scientific theories or on the production of solutions to certain problems generated by previously accepted theories. As the first of these objectives is reserved for periods of pre-scientific activity and revolutionary epochs, the individual scientist, for the most part, has as her aim to solve problems; she is committed primarily to the furtherance of normal science. On such a rendering, a Kuhnian seems to be able to affirm both the original statement and the Truth-Directedness condition.

Of course, the first way out of the problem is not without its own weaknesses. Primarily, one might wonder whether the claim that an individual scientist is not concerned with empirical truth is itself accurate. I do not have data to support this. Thus, I envision a second way out of the problem that avoids this worry. Kuhn could still be characterized as affirming both the problem-

[56]It may be worth noting that Bas van Fraassen makes the same distinction in *The Scientific Image* (Oxford: Clarendon Press, 1980), 8: "The aim of science is of course not to be identified with individual scientists motives."

solving claim and the Truth-Directedness condition if one takes him as identifying "aims" in the problem-solving claim with *immediate aims* and not with just any recognized or unrecognized aim. Since the fundamental activity of normal science is puzzle-solving, the immediate aim of the scientist will be identified as finding solutions to the puzzles, but the scientist is free to have recognized aims that lie beyond this. In other words, it is possible to ask her why she is engaged in the problem-solving activity to begin with, and she might give an answer that is not necessarily tied up with some other set of scientific problems. She may take such a question to be about her *fundamental motivations* that give rise to her inclination to consider the operative scientific problems in the first place. Seeking an answer to this question is not the province of the scientist *qua* scientist but *qua* philosopher of science. Construed in this way, pursuing truth is not an aim of science or the scientist properly speaking, though it is a motivational cause of scientific activity. Hence, on this way of considering the problem, we are still able to reconcile Kuhn's statement about puzzle-solving and the Truth-Directedness condition.

Sankey's Truth-as-Correspondence condition, that a "realist adopts a correspondence theory of truth, according to which what makes a statement true is that the world really is as the statement says it is," appears, on the surface, to be much more challenging for Kuhn to accommodate. However, the correspondence theory can be incorporated once Kuhnian idealism has been taken seriously.[57]

[57]The solution offered will not satisfy those, like Sankey, who deny the adequacy of any form of idealism in the first place. As Hoyningen-Huene, Oberheim, and Andersen argue in their review of Sankey's *The Incommensurability Thesis* ("On Incommensurability'" in *Studies in History and Philosophy of Science* 27.1 (1996), 131-141), "the debate about incommensurability is permeated by a meta-incommensurability between the realist and the non-realist which promotes local communication difficulties between the two parties" (138). They add: "to the realist the non-realist position seems self-contradictory but criticism of it often amounts to the stomping of one's feet, while to the non-realist, realists appear utterly naive because they refuse to realize that reality also contains genetically subject-sided moments." (139). In a separate article, Oberheim and Hoyningen-Huene claim that meta-incommensurability is a real phenomenon and support it with an inductive argument: (P1) "If there were meta-incommensurability between the proponents of realist and non-realist philosophical interpretations of science, we would expect to find circular arguments, question-begging, and indecisive arguments when we survey the arguments used for and against

The Kuhnian notion of truth does not involve a denial of external-world-correspondence simpliciter.[58] [59] Rather, it involves a denial that the aim in "evaluating scientific laws or theories, is to determine whether or not they correspond *to an external, mind independent world*" [emphasis mine]. In other words, Kuhn is concerned to discount the notion of correspondence between scientific theories, concepts, and laws and the pre-taxonomized object-sided world.[60] He would reject such correspondence because the external world of immediate concern for the

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realist and non-realist philosophical interpretations of science." (P2) The literature does provide a number of examples of exactly these sorts of circumstances. (C) Therefore, meta-incommensurability is a real issue ("Incommensurability, Realism and Meta-Incommensurability" in *Theoria* 12.3 (1997), 455ff). Sankey fails to seriously challenge the meta-incommensurability thesis, implicitly agreeing with his appeal that commonsense offers support to a realist understanding of scientific rationality (2009a, 201; "A Curious Disagreement: Response to Hoyningen-Huene and Oberheim" in *Studies in History and Philosophy of Science* 40 (2009), 210-212). Hoyningen-Huene and Oberheim go on to argue that the abandonment of a commitment to commonsense which has been central to the advancement of science favors the idealist conception ("Reference, Ontology, Replacement, and Neo-Kantianism (A Reply to Sankey)" in *Studies in History and Philosophy of Science* 40 (2009), 208-209).

[58]I am not the only one who claims this. Jouni-Matti Kuukkanen argues that Kuhn confuses the epistemological and evaluative notions usually associated with correspondence theory (e.g., foundationalism) with correspondence theory itself, which is said to involve an ontological aspect ("Kuhn, the Correspondence Theory of Truth and Coherentist Epistemology" in *Studies in History and Philosophy of Science* 38 (2007), 556-557). Dunja Šešelja and Christian Straßer have challenged Kuukkanen's account on the basis of Kuhnian idealism, arguing that, once one understands the nature of Kuhn's multiple-worlds thesis, one will also see the failure of a correspondence theory ("Kuhn and Coherentist Epistemology" in *Studies in History and Philosophy of Science* 40 (2009), 322-327). Thus, my allegiance with Kuukkanen is not without its concerns. Nonetheless, I suggest that their counterargument does not apply to my construal of Kuhnian idealism. On my account, what is generally meant by "correspondence" is the same whether one is S-referring or O-referring. Consequently, whether object-sided reference is possible or not is irrelevant to whether truth-as-correspondence is affirmable. Likewise, Kuukkanen rebuts, "All the correspondence theorist has to hold is that our chosen truth-bearers correspond in some sense to a certain state of affairs, not that the state of affairs is mind-independent" ("Closing the Door to Cloud-Cuckoo Land: A Reply to Šešelja and Straßer," in *Studies in History and Philosophy of Science* 40 (2009), 330. For further support of the inclination to think that Kuhn's rejection of correspondence theory was based on a misunderstanding, see Hoyningen-Huene (1993), 263-264 and Alexander Bird, *Thomas Kuhn* (Chesham, UK: Acumen Publishing, 2000), 225-227.

[59]Lest this qualification might sound like a case of special pleading, I offer one to consider the following article: Xinli Wang, "Taxonomy, Truth-Value Gaps and Incommensurability: A Reconstruction of Kuhn's Taxonomic Interpretation of Incommensurability" in *Studies in History and Philosophy of Science* 33 (2002), 465-485. In section 4, (472ff) Wang considers that Kuhn's focus is on truth-value conditions rather than truth-conditions. The shift in emphasis makes an open commitment to a correspondence theory of truth unhelpful to the discussion that Kuhn is trying to have, and so it becomes dispensable. Of course, Kuhn never works out such a distinction himself, and thus we are left with statements seemingly in conflict with one another. But Wang's presentation gives us a way out of the apparent contradiction that can rescue Kuhn and allow him to maintain a position like what I have presented herein. My presentation is most clearly corroborated by Wang on page 475. "Kuhn contends, following Putnam and many others, that although the correspondence theory of truth (that is, the idea that the substantial nature of truth consists in correspondence with the mind-independent world) has to be given up, the intuition behind it (that is, that the truth of a sentence is determined by its correspondence to a state of affairs external to the sentence) seems too obvious to be put to rest."

[60]By pre-taxonomized, I do not intend that one think of the world as an undifferentiated monistic whole. I do not use the notion metaphysically, but rather epistemically. It may be the case that the object-sided world does, in fact, have a natural taxonomy. Whether or not this could be discovered (and recognized) is an issue for another debate.

scientist just is a subject-sided world; and this world is mind-dependent because it is the result of taxonomic conceptualization.[61] Therefore, it would be improper to identify scientific reasoning, stocked with all its paradigmatic elements, with the pre-taxonomized object-sided world.[62] Hence, this sort of correspondence is ruled out by necessity. Nonetheless, Sankey's formulation of the correspondence theory does not require that "world" be taken mind-independently. All it requires is that the world that a scientist speaks of really is external, and that, in principle, statements can be either affirmed or denied of it. Thus, so long as the world under consideration is identified as Kuhn's subject-sided world, and so long as scientific statements are made within the context of the same lexicon that informs the relevant experience of the world, I see no reason why Kuhn could not, in principle, affirm the Truth-as-Correspondence condition.[63] [64]

Finally, we must attend to Sankey's Metaphysical-Realism condition, that "scientists investigate an objective reality, whose existence, structure and properties are independent of human mental activity." Once again, when we distinguish between the subject-sided and object-sided worlds, Kuhn has the tools to affirm this statement without revising any aspect of his general position. There is no reason to doubt that Kuhn believes the object-sided world would continue to exist independent of human mental activity. What he would deny is that a subject-

[61]Recall that, according to the Kuhnian notion of reference, this world will be considered as external in an important way. Of course, I have not *yet* given an account that offers justification for taking it in this way. See Chapter Four.

[62]One might be inclined to question the notion that scientific activity must be about the subject-sided world and not possibly about the object-sided world. They key to understanding this affirmation is to understand the role of communication in science and the connection of affirmation/denial to intensional communication. A key aspect of natural science is that it is not just a discipline of raw experience and ostensive acts of communication. Rather, it is a discipline which combines ostensive and intensional acts of communication; the latter of which require language, and hence involve a conceptual lexicon. Where communication is completely ostensive, the notion of truth is useless (how could one make sense of a denial on the basis of a mere gesture). It only comes into play when the objects discussed have been conceptualized – linked together with the elements of a lexicon. If this is the case, and if lexicons are in some important sense conventional, then meaningful truth-attribution will always involve at least some conventional aspect as well.

[63]Recall that earlier in the chapter we saw Nola making a similar observation.

[64]This seems consistent with Kuhn's account of truth-attribution: "To declare a statement candidate for true/false is to accept it as a counter in a language game whose rules forbid asserting both a statement and its contrary" (1990, 100). So long as the subject-sided world is a partial product of the paradigm through which the rules are applied, it will mirror the paradigm and, thus, a story of correspondence can be told.

sided world, a world conceived according to a given taxonomy and filled by theoretical entities, would exist apart from cognition. Moreover, there is no transparent reason to worry that Kuhn's object-sided world would lose any power to induce minds into having a subject-sided experience were human minds to reappear. Hence, the independence of the object-sided world's properties is in no certain danger of being lost by the acceptance of Kuhn's mature doctrine.

3.III.C.2 Critiquing the Response to the Distinct-Entities Argument

Let's now reconsider the articulations of Kuhnian thought that Sankey identifies as importantly problematic. The first of these is the Distinct-Entities Argument:

> In the transition between theories, there is radical change in description of the entities postulated by theories, so that later theories refer to none of the entities to which earlier theories referred. Thus, the advance of science evidently does not yield an increase in truth about a common set of entities. (Sankey, 1998, 11-12)

Now recall Sankey's quick response:

> The force of this argument may be blunted, however, by means of a causal theory of reference: to the extent that reference is determined by a causal relationship between speaker and reality, it need not vary with change in description of the entities postulated by theories. (ibid., 12)

The critical response to the Distinct-Entities argument rests upon an equivocation. The argument as stated affects Kuhn only insofar as the things discussed, those identified as "postulated," are considered as subject-sided entities. For only subject-sided entities can be conceived as distinct from one theory to another. However, making an appeal to the causal theory of reference involves a gesture towards a different set of things, those of object-sided experience. But the object-sided objects are not distinct for Kuhn from theory to theory.[65] [66] [67] This may become

[65]N.B. The relation between an object-sided and subject-sided things will be discussed in detail in the next chapter.

[66]Kuhn had open reservations about using the causal theory of reference to ground any empirical facts other than perhaps the identification of distinguishable objects – e.g., naming (see Thomas Kuhn, "The Natural and the Human Sciences" (1989) in *The Road Since Structure*, 219-220 and "Dubbing and Redubbing: The Vulnerability of Rigid Designation" (1990)). Kuhn's primary contention is that scientific concepts are not learned in isolated instances of

clearer if considered under the terms of the theory of reference discussed earlier. The Distinct-Entities argument is about the proper objects of S-reference and the responsive statement is about the proper objects of O-reference. Since there is no extensional overlap between these sets of things, a point which rests upon the stipulation that object-sided terms do not S-refer and subject-sided terms do not O-refer, it will not do to try and use one set to solve a reference problem with respect to the other. In other words, the Kuhnian picture I have elaborated in the §3.II.B has all of necessary elements to accommodate the intuitions driving both the Distinct-Entities-Argument and the response.

So, Sankey's responsive statement is not necessarily inconsistent with anything believed by Kuhn. Thus, supposing that Sankey's own statement is consistent with a denial of antirealism, then it remains possible that an idealist Kuhnian position can be construed as non-antirealist as well. Of course, whether the Kuhnian idealist actually can consistently maintain non-antirealism depends on whether the Distinct-Entities argument and the responsive statement are, in fact, consistent. But, as was discussed earlier, there is no obvious logical inconsistency in Kuhnian idealism. Thus, no clear reason has been given why Kuhn could not affirm both the Distinct-Entities argument and the response simultaneously.

3.III.C.3 Critiquing the Response to The Non-Evaluativity Argument

I now turn to the second of two articulations of Kuhnian thought that Sankey identifies as importantly problematic, the Non-Evaluativity argument. Sankey claims:

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designation, but rather they are learned under circumstances where they are compared both to members of the set to which they are included as well as to members of contrast sets. With respect to the descriptions of diverse entities, Kuhn thought the causal theory to be quite limited (see Thomas Kuhn, "Possible Worlds in the History of Science" (1986) in *The Road Since Structure*, 77ff). In the following chapter, I develop what I think can be construed a causal theory of correspondence between objects and entities, but one that does not involve the reference of scientific terms.

[67]It seems to me that Hoyningen-Huene and Oberheim pick up on this as well when they point out that "there is a difference between reference to *kinds* by terms used in *stating* theories, and reference to *specific samples of those kinds* by the same terms in specific predictions of those theories" (2009, 204).

> Kuhn infers from untranslatability between a pair of theories that there is no sense in which one may be closer to the truth than the other … that there is no basis on which to judge that theories are closer to the truth. (Sankey, 1998, 12-13)

To begin, the Non-Evaluativity argument does not seem to be obviously attributable to Kuhn. I am hesitant to ascribe it to him on the basis of each of the following clauses: "there is no sense in which one may be closer to the truth than the other" and "there is no basis on which to judge that theories are closer to the truth." Kuhn is clear that there is *some sense* in which evaluations regarding the truth of theories can be made:

> Something like a redundancy theory of truth is badly needed … something that will introduce minimal laws of logic … and make adhering to them a precondition for the rationality of evaluations. On this view … the essential function of truth is to require choice between acceptance and rejection of a statement or a theory in the face of evidence shared by all. (1990, 99)

Moreover, he also thinks that there is *some basis* on which to make such evaluations, which, again, is evident in both the oft-referenced claim that one is not free to experience the world however they wish, and in the "evidence shared by all" clause above. Of course, Kuhn also maintains that a choice between statements or theories will be paradigm-driven, or "fallible and theory-laden" as Sankey puts it.[68] And one would think that this is exactly the problem that Sankey aims to overcome. Oddly enough, however, he discounts this implication, identifying it as "surely a different issue." This dismissal initially appears to undo the strength of the criticism, putting him in the awkward position of being, at one time, both critical and accepting of the inability to escape one's paradigm in order to make truth judgments. But I suggest that Sankey's dismissal helps us to see that what is actually bothering him is not that he wants just any way to evaluate theories. Rather, he wants to establish a ground for appealing to some higher order paradigm – a natural language of sorts. For a causal theory of reference conjoined with a natural language would obviously make it *much easier* to establish the conformity between a subject-

[68]Sankey (1998), 13.

sided entity and an object-sided thing. So, if Sankey is to convict Kuhn of antirealism, he must do so on the basis of the following commitment:

> Kuhn infers from untranslatability between a pair of theories that there is no sense in which one [*subject-sided taxonomy*] may be [*proven to be*] closer to the [*object-sided*] truth than the other [*subject-sided taxonomy*] … that there is no basis on which to judge that [*subject-sided*] theories are closer to the [*object-sided*] truth.

This statement really does reflect Kuhn's position and his rejection of a higher order natural language. Nonetheless, it is not obvious that it entails antirealism.

Perhaps a consideration of Sankey's elaborate response to the Non-Evaluativity Problem can help us make the connection. His general response and supporting statements are as follows:

> G: "Rival theories may make more or less true claims about the same entities, despite untranslatability."
>
> S-1: "It is extremely implausible to suppose that conflicting theories *about the same domain* might be incapable *in principle* of being more or less true than one another."
>
> S-2: "The inability to translate between theories does not entail that one theory may not be closer to the truth than another" since "truth depends on reference rather than sense."
>
> S-3: "There is no need to formulate propositions within the lexicon of a single theory in order to compare them for truth" since "the lexicon of a theory is the special vocabulary of a theory, which constitutes a local fragment of an embracing natural language."

Concerning the general claim, Kuhn certainly thinks that different theories are *about* the same objects (things residing in the object-sided world). This is a prerequisite for scientific idealism, as was established earlier in this chapter. What he would deny is that scientific terms actually *refer* to these objects. It is this latter denial that makes it hard to imagine how the Kuhnian idealist could affirm claim G. For the "more or less true condition" seems to require the ability to refer scientific terms to object-sided beings. Let's consider this in light of Sankey's elaborations.

Reading S-1 as a criticism of Kuhn is problematic for a couple of reasons. First, it is not clear that Kuhn would deny the claim given the *in principle* proviso. For instance, because he

believes that the object-sided world restricts the sorts of subject-sided characterizations that can be applied to it, there is no reason to suppose that it would be impossible for there to be a being that could identify the actual taxonomic cuts in the object-sided world, supposing that there are such cuts. Perhaps, however, Sankey would respond that *in principle* be taken as *in principle for humans* as we know of them. This reading, though, raises a second problem for Sankey, namely, that the implausibility is not intuitively apparent. If different people have distinct interactions with the object-sided world, and if those interactions happen to be grossly limited with respect to the total evidence, and if these people only have partially-developed lexicons for characterizing the world, then it is not obviously implausible that incompatible, albeit equally consistent,[69] ensembles of beliefs about the world can be upheld by different people. But if such a scenario is possible, then the basic rules of inference alone would not be able to adjudicate between the views. And if the Kuhnian theory of reference I have laid out is acceptable, then it is highly plausible that conflicting theories could fail to be distinguished by their ability to acheive object-sided correspondence.[70]

Citing S-2 as a criticism of Kuhn is confused as well. First, it is not at all clear that Kuhn takes the untranslatability doctrine as the basis for the truth-determination problem. Rather, these are both symptoms of something more fundamental, namely, a belief that the object-sided world does not invariably communicate a natural taxonomy to scientific perceivers. Second, on Kuhn's construal, the entities of scientific reference do not lack paradigmatic determination, and thus they are not free from being identified according to this sense. Nor could they ever become so. In

[69]I say equally consistent because I do not want to assume that either is, or even can be, totally consistent.
[70]My contention that S-1 is consistent with Kuhn's own view with respect to human understanding is also supported by his claim that a lexicon "gives members of the community that employs it conceptual access to an infinite set of lexically stipulated worlds … As time passes, continuing research excludes more and more possible worlds from the subset that could be actual. If all scientific development proceeded in this way, the progress of science would consist in ever closer speciation of a single world, the actual or real one." (1986a, 76).

fact, a request for the comparison of scientific theories on the basis of reference alone could not be a request for the truth regarding the relation between the subject-sided world and the object-sided world, which is the matter of concern for the reformulated Non-Evaluativity problem. Rather, it must be a request for the comparison of a subject-sided term to a subject-sided world. Finally, in order that a request for comparison could be about the adequacy of subject-sided terminology in accounting for the character of the object-sided world, it would have to be possible for subject-sided terms to cross over. But this has been ruled out as a possibility by my Kuhnian theory of reference.

Finally, invoking S-3 as evidence for Kuhn's antirealism clearly illuminates Sankey's misunderstanding of Kuhn. First, it misses the fact that the "natural language," or metalanguage as it is elsewhere identified, has no object-sided referent; it is an enriched lexicon composed of descriptive representations of all of the subject-sided-entities that are found in all of the other standard lexicons. For every object in the object-sided world, this natural language lexicon will have a number of incompatible object-characterizations that are supposed (by those who use a standard lexicon, not by those who use the enriched lexicon) to represent it. These object-characterizations are able to coexist within the metalanguage only insofar as they are considered to be distinct *conceptual representations of* subject-sided entities, not insofar as they are taken to be externally instantiated beings (whether in the subject-sided or object-sided sense). Second, the enriched lexicon is possible only insofar as a person making use of it admits an open unconcern for truth and falsity, a point discussed in the previous chapter. As such, the sorts of comparisons that can be made are not truth-functional. From all that has been said, then, it is clear that none of the three supporting arguments offered by Sankey stick to Kuhn, and so they do not substantiate the identification of Kuhnian doctrine with the antirealism thesis.

3.III.D Concluding Remarks on the Charge of Antirealism

In summary, neither Kuhn's own statements, nor the arguments formulated by Sankey have successfully shown Kuhn to be committed to antirealism. In fact, by considering Sankey's attempts to attribute antirealism to Kuhn, a substantive misunderstandings of Kuhn's own commitments by Sankey is discovered (most importantly, those related to the nature of Kuhnian idealism and the corresponding doctrine of reference).[71] Since the misunderstandings have been identified and cleared up, this particular charge of antirealism has nothing left to stand on.[72]

3.IV CONCLUSION

In this chapter I have partially argued against the charge that Kuhn has adopted a position that clearly leads to total-relativism. First, I contended that, while Kuhn is an idealist, he should not be construed as a total-relativist on the basis of his doctrine of reference. Then I argued that he is not antirealist according to Sankey's standards, and so he cannot be saddled with total-relativism on that ground either. Therefore, my interpretation paints Kuhn's position as an idealistic-non-antirealism. This is certainly an awkward locution, but I have chosen to use it because I want to avoid an ambiguity that permeates the discussion in the secondary literature. It is unfortunate that the alternative to idealism, which Kuhn rejects, is called "realism" while the alternative to antirealism, which Kuhn seeks to affirm, is also called "realism." But these two "realisms" are conceptually distinct. I call the first (which contrasts with idealism) metaphysical

[71]There are others who attempt to unite Kuhnian thought with non-antirealism. For example, Kuukkanen writes that "despite its anti-realist credentials," Kuhn's philosophy is compatible with some form of realism (2007), 555. Of course, he is arguing for a form of methodological realism rather than a form of ontological realism, but it seems clear that these are fundamentally related.

[72]There may, of course, be other possible formulations of antirealism that Kuhn could not evade. For example, a definition requiring an ontologically accurate mapping of the subject-sided world onto the object-sided world *and* epistemic assurance that the map fits would be something that Kuhn could not affirm. But one wonders whether anyone could evade antirealism on such a rendition.

realism and the second (which contrasts with antirealism) transcendental realism (which is not to be confused with Kantian transcendental idealism, see Chapter Four).[73] [74]

Thus, I see no reason, once a distinction has been recognized between these two realisms, that prevents Kuhn from being consistently identified as a non-antirealist, a non-total-relativist, and an idealist. Of course, I also recognize that the total-relativism worry is not wholly settled, for the tethering problem – whether subject-sided and object-sided worlds can be ontologically tethered together in such a way that is cognitively relevant towards maintaining an intermediate position on the relativism scale – has not yet been resolved. I will now proceed address that problem.

[73]N.B. Alexander Bird makes a similar distinction with respect to antirealism in his 2003. One might also make the case that Kant is committed to a similar doctrine insofar as he promotes both transcendental idealism and empirical realism.

[74]For an example of the confusion within the secondary literature, consider that Sankey is critical of Hoyningen-Huene because of his idealism, and thus casts him as upholding an antirealism (1997, 18ff; 2009a, 199). Thus he conflates a denial of metaphysical realism with a denial of transcendental realism. Hoyningen-Huene, on the other hand, does not object to the conflation, for he is adamant to disavow Kuhn of the metaphysical realist label. He never explicitly considers the distinction between metaphysical and transcendental realism and thus sounds like he rejects a metaphysical commonality on the object-sided division of reality (1996). At other times he seems to graciously accept the label. For example, he and his coauthor Oberheim (1997) argue against saddling Kuhnian incommensurability with the realists who stand against Van Fraassen. (See also 2009, 203).

CHAPTER FOUR:
TETHERING THE KUHNIAN WORLDS

In this chapter, I develop an ontology and a theory of cognition that is consistent with Kuhn's mature account of incommensurability, the brand of metaphysical idealism described in Chapter Three, and what I have termed as non-antirealism, or transcendental realism. In order to satisfy my end, the account must be able to feature a tether between the subject-sided and object-sided worlds so that scientists who adhere to distinct paradigms can be said to knowingly refer to a single world of objects in one, fundamental sense and to distinct worlds of entities in another important, though non-fundamental, sense.[1] Once I have developed and offered a preliminary defense of the position in §4.I-§4.IV, I consider a potential challenge to the final product, namely that my account falls victim to "The Myth of the Given." I take up that concern in §4.V. If the account herein is plausible, then a Kuhnian position that is able to avoid total-relativism with respect to scientific experience appears to be theoretically viable.[2]

4.I KUHN'S KANTIANISM?

The basic structure of the Kuhnian ontology I develop has already been identified as an idealist one. The idealism that is involved has drawn comparisons with Kant's transcendental idealism, and for good reason since Kuhn himself referred to his position as a Kantianism with

[1]As a quick reminder, I would like to point out that I use "objects," "entities," and "items" in a technical sense. "Objects" are external things in the object-sided (non-paradigmatically influenced) world. "Entities" are external things in a subject-sided (paradigmatically influenced) world. "Items" are mental things in either kind of world. "Things" is a generic placeholder for objects, entities, or items when distinguishing them is undesirable.

[2]My account does not need to be demonstrably true or explanatorily complete in order to be successful given my immediate purposes. I admit that it is in need of further development, particularly with respect to empirical support. In short, this chapter is conceived as a starting point for a more systematic account to be developed in the future.

changeable categories.[3] Moreover, Hoyningen-Huene's notions of subject-sided experience and object-sided experience, which I have adopted, are modeled after Kant's distinction between the noumenal and phenomenal worlds.[4] However, the comparison between Kuhn and Kant is easily overstated. Thus, I begin this section by identifying the general similarity between the Kuhnian and Kantian idealisms. Then, I argue that a significant dissimilarity is involved that importantly differentiates the positions.[5]

For Kant, there are two kinds of *a priori* principle that structure empirical experience: the pure forms of intuition and the categories. Identifying the differences between these structures is not a matter of serious concern for my purpose, so I simply group them together as the *a priori* structures, or structuring principles, of empirical experience. Of course, a structure can only do its work if there is something to structure. On Kant's view, this is the pre-perceived (*noumenal*) world. The Kantian noumenal world does not conform to the post-perceived world of empirical experience, the world as experienced *through* the structuring principles.[6] Kant calls this second world the *phenomenal* world. Given this distinction between worlds, it is appropriate to identify the pre-perceived, noumenal world as a sort of raw object of empirical experience, and not as the actually experienced object. The actual object of experience, the phenomenal world, is a construction involving both the raw object and the structuring principles. When a construction

[3]Kuhn refers to his view this way in a number of places including his 1977 "Metaphor in Science" (204), his 1990 "The Road Since Structure" (104), and 1993 "Afterwords (245). The pagination for each refers to Thomas Kuhn, *The Road Since Structure*, ed. by James Conant and John Haugeland (Chicago: The University of Chicago Press, 2000). I will refer to these articles as (1977), (1990), and (1993), respectively.

[4]See Eric Oberheim and Paul Hoyningen-Huene, "Reference, Ontology, Replacement, and Neo-Kantianism (A Reply to Sankey)," in *Studies in History and Philosophy of Science* 40, 2009, 205-206, 209.

[5]My aim is to take up a challenge once offered by Alexander Bird, who surmised, "maybe, one could develop a naturalistic, neo-Kantianism without built in scepticism vis-à-vis the world-in-itself." In other words, I share Bird's interest in the possibility of a multi-world construal that does not require that the object-sided world be taken as a mysterious, pre-perceived thing-in-itself, so I formulate an account that satisfies the interest. For it seems clear that removing the skepticism is necessary before one could go on to establish a tether between the subject-sided and object-sided worlds. See Alexander Bird, "Incommensurability Naturalized," in *Rethinking Scientific Change and Theory Comparison: Stabilities, Ruptures, Incommensurabilities*, edited by Léna Soler, Paul Hoyningen-Huene, and Howard Sankey, Dordrecht, The Netherlands: Springer (2009), 37.

[6]See Immanuel Kant, *Critique of Pure Reason*, 76/102-80/106.

has taken place, the *a priori* structuring principles are thought responsible for both the unity and content of actual empirical experience.

Kuhn also identifies empirical experience as a construction with a structuring element (scientific concepts) and a raw element (the object-sided world). Thus, it is not unreasonable for him to have identified as a Kantian of sorts.[7] Nonetheless, Kuhn clearly parts ways with Kant with respect to the character of both the structuring principles and the pre-perceived world. For Kant, the raw object of experience is absolutely ineffable; the fundamental features of an empirical experience – e.g., spatio-temporality, causality, and substantiality – are identified as *a priori* structures rather than as features of the pre-perceived object. To characterize the pre-perceived world without access to such notions turns out to be an inconceivable task. On the contrary, although Kuhn sometimes talks of the ineffability of what has been dubbed the Kuhnian object-sided world,[8] it is clear that his understanding is much more moderate than Kant's. For, Kuhn's characterization of the object-sided world is of a ready-made system of external stimuli, sense organs, and neural processes.[9] As was seen in Chapter Two, he claims that distinct agents endure the actions of the same stimuli and undergo individually distinct, albeit qualitatively similar, responsive physical processes. From this description it seems clear that, as Hoyningen-Huene details, "Kuhn stipulates this world to be *spatiotemporal*, *not undifferentiated*, and in some sense *causally efficacious*."[10] In other words, because Kuhn's pre-experienced,

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[7] As Dunja Šešelja and Christian Straßer put it, "Like the Kantian categories, the lexicon supplies pre-conditions of possible experience.' And as the lexical categories change, both in a diachronous and a synchronous manner, 'the world . . . alters with time and from one community to the next.' Kuhn compares a permanent, fixed, and stable foundation 'underlying all these processes of differentiation and change' to 'Kant's Ding an sich,' which 'is ineffable, undescribable, undiscussable.'" ("Kuhn and Coherentist Epistemology," in *Studies in History and Philosophy of Science* 40 (2009), 326.)

[8] Thomas Kuhn, "The Road Since Structure," 104

[9] Thomas Kuhn, "Postscript," in *The Structure of Scientific Revolutions*, 3rd Edition (Chicago: University of Chicago, 1996) 195. See also (1993), 249.

[10] Paul Hoyningen-Huene, *Reconstructing Scientific Revolutions: Thomas S. Kuhn's Philosophy of Science*, (Chicago: University of Chicago Press, 1993), 33-34. See also Wang, Xinli. 2002. "Taxonomy, Truth-Value Gaps

object-sided world is appropriately characterizable with spatio-temporal and causal notions, his *a priori* structuring principles are to be identified with "lower level principles" than Kant's.[11] Thus, Kuhn's object-sided world is not a mere reiteration of the mystical noumenal reality that many believe was proposed by Kant. Rather, it is a subject of "common" experience in a way that Kant's is not.[12]

4.II THE ACCESSIBILITY OF THE OBJECT-SIDED WORLD

This qualification provokes the question: In what manner might the object-sided world be characterized as "commonly" experienced? Any answer to this question must accommodate not only the immediate claim that the object-sided world is, in fact, experienced directly, but it must also sustain the thesis that the object-sided world is both scientifically indeterminate and, yet, can nonetheless play the role of a limiting force on scientific theorizing. In order to satisfy each of these restrictions, it will help to first distinguish between three fundamentally distinct cognitive activities, which I identify as *pure observation*, *conceptualization*, and *common observation*. In distinguishing these operations, I can identify the way that the object-sided world can be said to operate on, and interact with, the human perceiver. Thus, the net result of this inquiry is a characterization of both the process by which subject-sided worlds come to be and an account concerning certain aspects of the nature of the object-sided world. I begin by giving a quick (and

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and Incommensurability: A Reconstruction of Kuhn's Taxonomic Interpretation of Incommensurability," in *Studies in History and Philosophy of Science* 33, 472 and Alexander Bird, "Kuhn, Nominalism, and Empiricism," in *Philosophy of Science* 70.4, 716.

11See Andrew Chignell, "Neo-Kantian Philosophies of Science. Cassirer, Kuhn, and Friedman" in *Philosophical Forum* 39 (2009), 255-256.

12Kuhn famously claims to be a Kantian without the things-in-themselves (1977, 207). At first glance, this may seem to conflict with an account which identifies any sort of Kuhnian object-sided world-in-itself. Nonetheless, given what has just been discussed here, it seems clear to me that he does not intend to deny the existence of an object-sided world altogether, but simply the Kantian understanding of its nature. Others seem to agree. For example, Jouni-Matti Kuukkanen writes, "it is doubtful that Kuhn was inclined to any kind of full-blooded idealism that discounts the existence of the mind-independent world" ("Closing the Door to Cloud-Cuckoo Land: A Reply to Šešelja and Straßer," in *Studies in History and Philosophy of Science* 40 (2009), 328). See also Howard Sankey's "Incommensurability: The Current State of Play," in *Theoria* 12 (1997), 425-445.

admittedly schematic) description of the elementary differences between these three activities. Then, I go into further detail about the nature of each one.

To begin, there are two primary senses in which I take these cognitive operations to be distinguishable. First, these operations are distinguishable by the causal relationship that stands between the perceiver and the perceived in the former's exercise of the cognitive faculties. I construe pure observation as a mentally passive operation from the standpoint of a perceiver. So the cause of pure observation is primarily external.[13] Conceptualization, on the contrary, is a mentally active operation from the standpoint of the perceiver. So the cause of conceptualization is primarily internal.[14] Lastly, common observation is causally synthetic. The operation is partly active and partly passive from the mental standpoint of the perceiver. The character of these causal relationships become clearer as the section unfolds.

The second general way in which I take these operations to be distinct is that each has its own unique proper object. When one is engaged in an act of pure observation, she experiences the object-sided world alone. As Kuhn might explain it, pure observation involves "situations drawn directly … from nature."[15] Conceptualization involves the experience of solely mental items (i.e., ideas in the mind). Finally, common observation involves an experience of entities and events in a subject-sided world. Below, I show that the subject-sided world is actually a

[13]For the sake of brevity, I purposefully ignore any concern for the representational activity that occurs during the neural portion of the perceptual process. Obviously, this is an internal function that plays a role in one's perception. In short, I am assuming that this process is both determinate (lawlike) in its operation and more-or-less uniform throughout humankind. As such, it will not play an important role with respect to the differentiation of my subject-sided worlds. I willingly grant that these are assumptions on my part and that they constitute a point of potentially serious criticism from the standpoint of a neuroscientist. I leave the identification of such problems and the possibility for solutions to them.

[14]Again, I recognize the possible blank-slate-empiricist rebuttal that an external cause is the impetus for this activity, and so it is not entirely internal. Once again, my willingness to cast the activity as primarily internal betrays my assumption that the causal process leading to and through pure observation are lawlike and uniform for human perceivers; and so it is subject to the same challenges mentioned above.

[15]Thomas Kuhn, "Dubbing and Redubbing: The Vulnerability of Rigid Designation," in *Scientific Theory: Minnesota Studies in the Philosophy of Science* 19, edited by Savage, Conant, and Haugeland (Minneapolis, MN: University of Minnesota Press, 1990), 304.

compositional entity with an object-sided moment (c.f., the "raw" element of empirical experience) and a subject-sided moment (c.f., the *a priori* element of empirical experience). Let us consider each of these activities in more detail.

4.II.A Pure Observation

When one engages in an act of pure observation, she experiences what Aristotelians have identified as a substance's transcendental features, namely being and unity.[16] First, with regard to "being," I (following Aristotle[17]) have in mind the most general property that all perceivable objects possess. This property is so basic that it is conceptually indistinguishable insofar as it is manifested by distinct objects.[18] Because being has the feature of relative indistinctiveness, I infer that there is no useful analytic characterization of it. Therefore, I take being as roughly equivalent to Kant's famous conception of "existence" – it is a property that makes no conceptual difference when superadded to an essence.[19] Nonetheless, though being should be construed as conceptually empty, it would be inappropriate to infer that it is phenomenologically inert as well.[20] For there is, I take it, an important sense in which being is made known[21] to the

[16]Aristotle introduces the transcendentals in *Metaphysics* X.2. Historically, a number of other features of being (including goodness, beauty, and truth) have been considered as well (see Thomas Aquinas, *On Truth* I.1 and *ST* 1a.5.4. ad 1). If concern with "being" is restricted to a concern for "empirical being," then I can imagine at least the possibility of including some other properties on the this list of transcendentals (e.g., size, shape, solidity, etc.). In any case, focusing on just the original transcendentals gets me everything that I am after here, so I don't discuss the other possibilities any further. But the possible application of the other transcendentals to a Kuhnian doctrine of reality would likely be an interesting project.

[17]Of course, Aristotle is not alone in his recognition of transcendental features in experience. For example, John Locke identifies the same properties similarly, "Existence and unity … are suggested to the understanding by every object without and every idea within." See John Locke, *An Essay Concerning Human Understanding*, edited with an introduction by Peter H. Nidditch (Oxford: Oxford University Press, 1975), II.vii.7.

[18]Aristotle argues that being is not a true genus because it does not distinguish objects ("Metaphysics," ibid.).

[19]Kant, *Critique of Pure Reason*, 598/626. Like "existence," "being" might be best construed as an activity itself – thus making the fundamental principle of ontology on my account an activity rather than a substance.

[20]Hume went so far as to say that it is not even distinct from the individuals themselves, "The idea of existence, then, is the very same with the idea of what we conceive to be existent." David Hume, *A Treatise of Human Nature*, second edition with text revised and notes by Peter H. Nidditch and an analytical index by L. A. Selby-Bigge (Oxford: Oxford University Press, 1978), 1.2.6. I disagree with Hume insofar as it seems possible to me to distinguish the activity of a thing from the thing itself. Being, as construed here, is considered an activity of sorts, though admittedly one that is so fundamental that it is not separable from the thing itself.

one who is encountered by it, though not in such a manner that the perceiver is determined to a specific conceptualization of the object to which the being belongs.

While this might, at first, seem to be an odd claim, it appears to me to be obvious that we do, occasionally, confront reality in a conceptually obscure manner. For example, imagine that you are standing on your patio and you suddenly become distracted by a pinch-like sensation on the back of your arm. Soon after the sensation, you might begin to consider the possible cause or causes of such an experience. For example, it could be that your sadistic neighbor has snuck up behind you and poked you with a needle. Then again, perhaps you have simply been bit by a tiny bug or stung by a bee. Of course, it may be the case that no sentient being was directly involved at all, but that a tiny rock or some other projectile object had been launched by your neighbor's air condensing unit as it kicked on. Or it could be that what actually happened was that the sunlight had been briefly concentrated into an intense beam as it passed through a decorative prism-like piece of glass on a wind-chime hanging from your soffit, and proceeded to find its way to the back of your arm. Finally, it is even conceivable that the cause of the experience was not actually an external object at all, but rather that your tricep was brought to painfully twitch because of some underlying neurological impetus.

There are a few things that seem clear from this scenario. First, while the exact character of the cause or chain of causes that actually brought about the uncomfortable feeling is unknown, it seems appropriate that the perceiver suppose the feeling to have been a real mechanical effect of either an actually present external object(s) or some actually ongoing mechanical process(es), rather than the product of some merely conceptual forerunner (i.e., an item of the imagination). The naturalness of this supposition is apparent if one simply considers that it seems more

[21]It is conceivable that there may be a variety of ways in which a thing might make itself known to another (e.g., mechanistic motivation vs. mystical revelation). I am primarily concerned with a mechanistic sense here.

reasonable to react to the pinch-feeling by either slapping, scratching, shaking, massaging, or moving out of the way than it would be to simply hope for the 'pain-on-the-back-of-my-arm' idea to conceptually dissipate.

Second, in this scenario the attempt at conceptualization is both logically and temporally posterior to the event itself. And it seems intuitive that this is how things ought to be construed; for to suppose that the conceptualization of the pain happened before the pain seems naturally inappropriate. Thus, one would be within her epistemic rights to believe that acts of empirical conceptualization are essentially reactive to, and so dependent upon, the presence of some actual object(s) or event(s). Furthermore, characterizing conceptualization as essentially reactive seems to imply that there must be information communicated to the perceiver that precedes the information produced in the conceptualizing activity. Hence, since this information precedes conceptualization, it should be identified as pre-conceptual. Therefore, any experience that starts with an impetus and ends in an act of conceptualization seems to involve at least two distinct kinds of judgment – an immediate judgment that an object or event is present and a secondary judgment concerning the specific character of that object or event.

Third, and finally, it seems reasonable to think that making conceptual determinations about the nature of an object(s) or process(es) involved in an event is wholly independent from the question of the presence of the object(s) or process(es) involved in the event. Nothing about the scenario above demands that, given the pain-experience, one must wonder about the nature of the cause of the pain. What's more, even if one did begin to conceptualize about the object(s) or process(es) involved, there is no reason to suppose that a determinative judgment on the matter must be accomplished. On the other hand, it is quite difficult to imagine a case where the pre-

conceptual existence question is not recognized as determinatively established, immediately and by natural habit, whether or not a successful conceptualization-event will follow.

In summary, I associate the transcendental property of being with an object's ability to communicate its presence, in a pre-conceptual way, to another object, and this in a way without any guarantee that an explicit communication of its character is forthcoming. Thus, in the same way, I contend that the object-sided world as a whole is able to naturally present itself to a normal human perceiver in an obvious, albeit conceptually obscure, way.[22]

The other transcendental that I mentioned is "unity." By unity, I understand the property of distinguishability, generally construed. The ability of an object to naturally communicate its distinctiveness is essential towards successfully establishing my Kuhnian account of non-antirealism. Kuukkanen reminds us that Kuhn felt the same burden: "Kuhn argues that if we cannot fix reference to an individual, we seem to lose referential stability."[23] Now, it seems uncontroversial that at least some objects of basic experience have a natural way of presenting themselves to a perceiver so that they are uniformly *experienced as* identifiably distinct items, even if these are not also uniformly conceptualized by different perceivers. I emphasize "experienced as" because I do not intend that this be taken as a deep metaphysical claim about the nature of the unity communicated. Rather, I intend that this uniform communication of unity be, in principle, agreeable to everyone – from the modern atomist who takes particles to be the

[22]Nancy Nersessian has discussed certain studies in child psychology in which children under one have spatio-temporal expectations about object-permanence but lack essentialist expectations. See "Kuhn, Conceptual Change, and Cognitive Science," In *Thomas Kuhn: Contemporary Philosophers in Focus*, edited by Thomas Nickles (Cambridge: Cambridge University Press, 2003), Section 7.2. This, I think, can be nicely accommodated with the story I am developing here. Spatio-temporality can be said to be the natural mode of experienced being. It is also sufficiently obscure with respect to other essential features.

[23]Jouni-Matti Kuukkanen, "Kuhn on Essentialism and the Causal Theory of Reference," in *Philosophy of Science* 77 (2010), 554. For Kuhn's own commitment to his ability to perceive individuality, see his "Metaphor in Science" (1977a) 200-201, "The Natural and Human Sciences" (1989) 219-220, and "Afterwords" (1993) 240-241. The pagination of each article refers to its presence in *The Road Since Structure*. Ed. by James Conant and John Haugeland. Chicago: The University of Chicago Press, 2000.

fundamental objects of the material world, to the dedicated monist, for whom all of reality is but a single substance and all distinctions are merely modal.

In short, what I have in mind here is that the object(s) or event(s) of pure observational experience possess a property by which they are naturally distinguishable from other object(s) or event(s) of pure observational experience.[24] Additionally, as was the case with being, I take it that unity naturally resists conceptualization, at least in a universally satisfying manner.[25] Furthermore, just as being does not need to be conceptualizable in order to be an epistemically relevant feature of object-sided reality, unity can have a phenomenological impact as well.

Here is an example to make the point clearer. Let us imagine that Leucippus, Aristotle, and Spinoza, without having been updated on twentieth century theoretic developments, have been reanimated and given access to an electron microscope with a fresh sample of red blood cells on display. They each look through the microscope and see the following image:

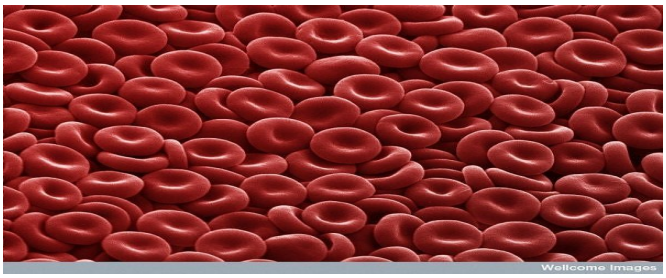

Figure 4.1 Red Blood Cells (Source: http://www.relativelyinteresting.com/the-great-microscope-challenge/)

Leucippus might identify each of the distinguishable things in this picture as a metaphysically distinct substance (an atom) and so he would construe the blood as a composite of substances.

[24]If spatio-temporality is identified as the mode through which being is communicated, then it might be conjectured that the property of distinction is spatio-temporal as well – a phenomenological border of sorts.

[25]Peter Van Inwagen, in his *Material Beings* (Ithaca, NY: Cornell University Press, 1990), has done a fine job of making the case that standard attempts to conceptualize individuation are too permissive. From this, he concludes that the only property that can account for the individuation of objects in all cases where the property is present is life. Thus, he concludes, the only true individuals are living objects. I do not disagree with van Inwagen that life is an individuating feature, or that it has some sort of metaphysical priority for designating individuation – it seems intuitive that the tree is more unified than the tables and chairs that material-object metaphysicians so often refer to. But I'm not comfortable in either (1) discounting altogether the individuality of the tables and chairs, as van Inwagen seems to do, or (2) ignoring obvious problem-circumstances for the life account (e.g., Siamese twins).

Aristotle would likely express disagreement, arguing that these are only *apparent* metaphysical objects. What is *really* seen is a formless[26] heap of matter in the process of degradation, which results when a material principle has been separated from its substantial animal form. Spinoza, on the contrary, would claim that what we really see is the substance of God made manifest in a unique mode (or group of modes). In short, our three observers would not agree about whether the things perceived are a group of substances, a part of a single substance, or even substantial at all. But they could easily agree with one another that the image contains a number of identifiably distinguishable units, irrespective of their exact metaphysical nature. In other words, reality communicates a complexity that naturally supports a conceptual division and does not require that an ontological characterization be available. Thus, the conceptually distinguished elements are naturally identified as particular units of a sort, even if not in the most metaphysical sense possible. Therefore, for our purposes, unity is conceived as the property of having a naturally communicated limit that serves as a potential ground for distinguishing either an object or its elements/parts/features from other objects or elements/parts/features.[27] What constitutes the limit and what the limit designates at a deeper level are entirely distinct questions.

Hence, in an act of pure observation, the perceived object communicates its most basic properties – being and unity – to a perceiver. And, insofar as something establishes itself as an object of perceptual experience, it seems epistemically legitimate to identify those features through which it establishes itself as "phenomenologically encountered." Finally, it seems that the phenomenological content of this activity would be consistent for all perceivers endowed

[26]Of course, it would not be completely formless – it would still possess accidental and elemental forms. It would only be formless with respect to a substantial form.

[27]The example used here makes use of the most primitive kind of border, the spatial one. The account does not preclude making divisions on more esoteric grounds as well (i.e., based on causal powers).

with the same cognitive faculties (e.g., for all humans who perceive via the five senses), since it is all pre-conceptual. This is how the Kuhnian could identify object-sided experience as uniform.

4.II.B Conceptualization

Conceptualization is the stage of cognition where paradigmatic elements are introduced. As stated above, conceptualization is both logically and temporally dependent upon pure observation. For to engage in conceptualization is to mentally systematize pure observational experience. There are two basic considerations involved in the completion of this cognitive task. I describe each of these below. Once I have done this, it becomes clear that the inclusion of this stage of cognition gives rise to the charge of subjectivism; for the most significant developments in conceptualization are subject to idiosyncratic influence. Hence, I close this sub-section by explaining why the apparent subjectivism is not pervasive. Thus, insofar as subjectivism seems to me to be equivalent to what I have identified as "total-relativism" in Chapter Three, the closing paragraphs of this section serve to stave off a worry that introducing a conceptualization stage in scientific cognition will transform Kuhn into a total-relativist.

One consideration in conceptualization involves the appropriation of a basic metaphysical framework.[28] The primary objective is to conceptually characterize the natural distinctiveness that is communicated to a pure observer by an object-sided being. There are two general possibilities with respect to how this can be done. First, one could interpret all perceived distinction as metaphysically univocal; that is, whatever presents itself as distinct is on equal metaphysical footing with all other objects that present themselves as distinct. Generally, a

[28]I use appropriation here to leave it ambiguous as to whether this is a creative act or whether the perceiver commits to an already established system of belief. In fact, if the perceiver is merely committing to an already established system, it doesn't matter whether this is a conscientious decision. In cases where it is not conscientious, the potential for later confusion is heightened. Of course, I do not presume that one who does make a conscientious decision at this stage cannot do so on merely provisional grounds, thus allowing for the possibility of future revision.

monistic take on reality seems best suited for such an interpretation.[29] Of course, once one has decided that distinctiveness ought to be construed in the univocal manner, one may still need to decide between different versions of monism (if multiple forms are devisable).

On the contrary, one could interpret the distinctiveness given through pure-observational experience as fundamentally analogical, so that distinction is hierarchically construable. This can be maintained in at least a couple of ways. First, one could identify the simplest elements of a composite as the most fundamental units of the experience. Thus, while (i) each red blood cell, (ii) the collective blood, and (iii) the source-being can be considered as distinguishable things, the red blood cells are taken to be the *most unified* things, metaphysically speaking. This rendering seems to be quite suitable for the standard atomistic interpretation of reality. On the other hand, one could chose to identify certain composite objects as being fundamentally unified. Thus, while it remains the case that (i) each red blood cell, (ii) the collective blood, and (iii) the source being can be considered as distinguishable things, one could deny that being the simplest element is sufficient for being the most fundamental thing. Rather, one could alternatively maintain that some composites have a higher degree of unity than their constitutive parts, thus rendering the composite as a more metaphysically-unified object. This rendering is consistent with the picture previously attributed to Aristotle.[30] [31]

[29]The reason that this interpretation seems appropriate for the monist is that they can identify all cases of perceived individuation as metaphysically illusory. Thus, in circumstances where one can identify a distinguishing border around both a part and a whole (e.g., an eye and a person), the monist can say that each is individual in the same sense – both are merely modal instantiations of "the one" and neither has ontological priority over the other. It would be unlikely that an atomist would hold a univocal view of the transcendental individuality that I have in view here. For this would require them to admit that, in some cases, a whole is an individual in the same exact way that its constitutive elements are, which seems absurd. Even the reductive atomist will admit that the wholes of experience are perceived as distinct individuals, though they are not admitted to be metaphysical simples. It is just as obvious that the Aristotelian view is not compatible with the univocal rendering.

[30]As I understand his view, an animal substance has the potential for decomposition, and thus the potential to become a pile of cells, each of which would have short lived individuality; but the cells are not metaphysically individuated in that state. Once the source-being has begun to decompose, that potential is temporarily actualized and the cells spring into existence as individuals of a sort, though not substantially so (i.e., through the possession of an intrinsic principle for sustained existence). Then, after some time, the cells are subsumed by a new host-substance

In addition to interpreting the character of the transcendental-unity expressed by the object-sided world, a perceiver is concerned with the taxonomization of her experience. This process has two distinct manifestations. One of these involves the organization of experience by dividing the objects of purely observational experience into categories that might be identified as natural kinds.[32] Kuhn characterizes this activity as the division of the objects of experience according to similarity and difference relations.[33] Now, since this occurs in the conceptualization stage, it must be cast as a mental activity. Thus, it is apparent that a genuinely Kuhnian position entails a variety of nominalism. A number of Kuhn's commenters have recognized this.[34] Some, following Ian Hacking, have suggested that Kuhnian nominalism necessitates that there are no *truly natural* kinds.[35] Jeffrey McDonough gives an explanation of this interpretation:

> On Hacking's interpretation, the world is a world of mind-independent individuals…. The work of distinguishing the world into classes is therefore left up to human beings whose classificatory systems may be more or less helpful, but do not reflect more or less accurately independently existing kinds.[36]

Others (including myself) however, do not think that this form of nominalism is a necessary implication of the Kuhnian position. While we would agree that the Kuhnian doctrine entails

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and, thus, reduced to potential individuals once again. Once a perceiver has decided to interpret the individuality of pure-observation analogically, she would need to decide between these forms of it, and most likely between several other varieties as well.

[31]It also seems to be the nature of the individuality that underlies van Inwagen's position (supposing that he doesn't take the most basic elements of reality to be alive or take living things to be non-compositional beings.

[32]There is no question that Kuhn takes this to be an important part of scientific experience. He discusses it quite clearly in "Second Thoughts on Paradigms," in *The Essential Tension*. Chicago: The University of Chicago Press. 293-319. Likewise, in "Metaphor in Science" he explains that the "redistribution of individuals among natural families or kinds,. . . is, I now feel, a central (perhaps *the* central) feature of the episodes I have previously labeled scientific revolutions" (205).

[33]Of course, as was the case in metaphysically characterizing the world, there are a many possible ways in which to cut up the world. See Kuhn's "Reflections on My Critics" (1970), in *The Road Since Structure*. Ed. by James Conant and John Haugeland. Chicago: The University of Chicago Press, 2000. 171-173.

[34]The most prominent is Ian Hacking, "Working in a New World: The Taxonomic Solution" in *World Changes: Thomas Kuhn and the Nature of Science*, edited by Paul Horwich (Cambridge, MA: The MIT Press, 1993), 275-310. Some other significant contributions include: Jeffrey McDonough, "A "Rosa Multiflora" by Any Other Name: Taxonomic Incommensurability and Scientific Kinds," in *Synthese* 136.3 (2003), 337-358; Alexander Bird, "Kuhn, Nominalism, and Empiricism," in *Philosophy of Science* 70.4 (2003), 690-719; Harold I. Brown, "Incommensurability Reconsidered," in *Studies in History and Philosophy of Science* 36 (2005), 149-169.

[35]Hacking (1993), 277.

[36]McDonough (2003), 346.

nominalism, it need only be construed as an epistemological variety, not a metaphysical one. For, as Alexander Bird has aptly said,

> One might have metaphysical reasons for thinking that universals must exist (because, for example, only with universals can there be laws and causes). Yet one might have epistemological reasons for doubting that we can be in any position to know which universals there are.[37]

Hence, it is possible, according to this rendering, that the object-sided world has natural divisions and that our attempts at scientific taxonomization really can approach the truth on these matters. However, I must qualify this claim by reminding the reader that nature does not seem to clearly communicate its taxonomic markers to us; at least, it does not communicate them as uniformly as it does the transcendental properties of the object-sided world. In short, the possibility that we are really approaching a true characterization of nature's taxonomic distribution can provide us with the hope for a true science, but it is not at all obvious that we have the ability to verify its possession if and when we have attained it.

Now, taxonomization does not end with the separation of objects into "natural kinds." Rather, it also involves (1) the identification of relations that stand between objects, and (2) the development of additional categories by which to characterize the world according to these relationships. There are a number of distinct kinds of relationships that might be identified at this stage, and I have no intention of providing a full list of them. Two of the more obvious ones with respect to the development of science are spatial relationships and causal relationships. But I see no reason to suppose that there are not many other significant categories that can be identified.

Once a preliminary division of the relationships has been made, one might immediately begin to identify relational regularities, and so to identify relational "laws" (or, in Kuhnian terms, symbolic generalizations). For example, one could observe that, with respect to spatial relations,

[37] e.g., See Bird (2003), 706.

there are a number of ways to imagine one object as closing in on another. However, one could also recognize that, of all the imagined situations, supposing that the conditions of the motion were inter-situationally consistent, and supposing that there were no barriers in the way of the moving object, the most efficient way to bring a moving object into contact with the other would be to have it proceed in a path characterized by a straight line. Hence, the geometric law "the shortest distance between two points is a straight line" is born.

Of course, it is certainly possible that the original division of relationships is deemed too general at first, and so a need to further subdivide one's relational categories may be conjured up.[38] For example, with respect to the causal relationships category, Aristotle famously envisioned a need to discriminate between four primary types: efficient, formal, material, and final.[39] But his sub-classificational work went beyond this level as well. For instance, formal causality was further subdivided into a number of distinct kinds (e.g., depending on whether a cause being considered was an elemental form, a vegetative form, an animal form, a rational form, or an intelligence). In fact, each of these subcategories was broken down as well, and there is no clear limit to how deep a taxonomy could run. In any case, only after a satisfactory subdivision of the relational categories has occurred can a search for laws commence.[40]

In closing this section on conceptualization, it is worthwhile to briefly address the worry of subjectivism (i.e., total-relativism). For, it is clear enough that, in virtue of being invented, the elements developed through conceptualization will reflect personal creativity and are subject to

[38]The perceived need to subdivide one's relational categories will be partly dependent on the conceptual character of those categories themselves, and partly dependent upon one's experience of the object-sided world. If one's relational categories are unable to accommodate and explain one's subject sided experience, or if they are not able to explain it well (per the perceivers own standards), then the subdivision might be attempted.

[39]Aristotle, *Physics* II.3.

[40]One should notice that in this stage we are introduced to theoretical entities such as lines, forms, and so forth. These are characterizable as the models in Kuhn's mature conception of paradigms (see Chapter Two). One can see how the Kuhnian conception of a paradigm can be nicely accommodated with the account I am giving here. Of course, nothing has been directly said about exemplars here, though my qualification concerning the appropriation of a metaphysical framework would seem to make room for that aspect as well.

individual evaluation. I, of course, do not deny this – it is part and parcel of scientific idealism. However, it is also clear that, supposing that one's cognitive apparatus for receiving the data of pure observation (1) has a natural function, and (2) is functioning well, there is a limit on the ways in which the object-sided data can be conceptualized. This limitation is entailed because all acts of conceptualization depend upon one's pure-observational experience. That is, because the distinguishing features of purely observational experience, being and unity, are prior to any conceptualization, any particular instance of conceptualization is subject to fit these object-sided limits at its point of origination. This point is supported by John Tresch's understanding of Kuhnian doctrine: "while knowledge cannot be understood outside of the social contexts in which it is embedded, there remain nonsubjective constraints that the world places on any consistent representation of it."[41] In fact, Kuhn himself, while discussing the character of scientific laws, claimed that an "experience with nature was essential to their initial formulation."[42] So, for instance, while a scientist could fairly challenge the Aristotelian "law" (i.e., the conceptualization) that the natural motion of fiery substance is to move away from the center of the universe, such a challenge would have been of a very different quality than if he were challenging the distinct claim that there are no empirical circumstances to which such a conceptualization could apply. A responsive challenge to the Aristotelian law of fiery motion would most likely involve a call to reconceive the universe's constituents, relations, and laws. But a responsive challenge to the second claim would not involve such an effort at all. A simple ostensive act of pointing at fiery circumstances would do the trick. In other words, one need only rely upon the natural communication of being and unity to undermine some empirical claims.

[41]John Tresch, "On Going Native: Thomas Kuhn and Anthropological Method," in *Philosophy of the Social Sciences* 31 (2001), 309.
[42]Thomas Kuhn, "Dubbing and Redubbing: The Vulnerability of Rigid Designation," 306.

4.II.C Common Observation

The final stage of cognition that I am concerned with here is what I have named common observation. As already mentioned, this stage is synthetic and results in making contact with a subject-sided world. In fact, I intend to adhere to a claim even stronger than this. As I envision it, common observation involves the generation of a subject-sided world. This generation is a result of a rather straightforward synthesis. A perceiver begins to see the being and unity of the object-sided world, the world of pure observation, through those categories that were developed in the conceptualization stage. The result is that the world experienced is seen as if there were some true metaphysical unity between the object-sided world and the subjectively established taxonomic and metaphysical concepts. This occurs without putting the transcendental features of pure-observational experience, being and unity, through any phenomenological alteration.

Let me explain this further by example. Imagine that you are sitting idly at the local park, enjoying your lunch break. Out of the corner of your eye, you notice a couple engaged in a romantic kiss. You see the face of one clearly, but you only see the back of the other. You notice that the individual you are seeing from behind is wearing a familiar hat, jacket, and shoes – they match those your father wears nearly every day. It it is plainly obvious to you that the woman whose face you see is not your mother. You become enraged at your father and begin working up a plan to confront him. Later that evening, you visit your parents' home with the purpose of addressing the issue. You step through the door and notice your dad sitting in a wheelchair with a brace around his neck and a cast on his leg. You think to yourself, "Mom already knows!" But then they tell you about how your father had fallen down the steps before breakfast and that they had spent the entire day in the ER. You quickly realize that the person at the park was not your father.

What then do you make of your experience at the park? Do you reason that the couple at the park lacked extra-mental being or unity? Of course not. Rather, you determine that the person must have been someone other than your father, but a distinct individual nonetheless. That is, you are naturally inclined to identify certain aspects of your park-experience as really tracking the object-sided world. But clearly, some other aspects of your experience were not successful at tracking the object-sided world. Most significantly, your first conceptualization has proven to be faulty. The elements of the example that represent the conceptualization stage are numerous. For instance, with respect to the entity that you wrongly identified as your father, you conceived it to be: (a) a man, (b) wearing a hat, jacket, and shoes, (c) engaged in a kissing act, (d) your father, (e) wearing your father's hat, jacket, and shoes, and (f) not kissing your mother. As it turns out, you may or may not have been right about (a), (b), (c), and (f), but you were definitely wrong about (d) and (e). Applying these concepts too hastily led you to perceive a non-father object through a set of conceptual categories that are specifically identified with your father. Thus, your conceptualization and the transcendental data were unified into a single empirical experience. But now that you have seen the error of your ways, you recognize that the park-event should have been conceived differently. And this distinct conceptualization results in a wholly different experience. Thus, it is clear that worlds of common experience are both like and unlike the object-sided world. Hence, I identify them as subject-sided worlds.

4.III KUHNIAN NON-ANTIREALISM

From the picture of cognition I have developed, it should now be clear why I think that a Kuhnian version of scientific idealism should be construed as transcendental realism rather than antirealism. Whereas the world of the scientists is always subject-sided (since it is fundamentally

concerned with the world as seen through a theoretic apparatus invented via conceptualization), it does not entail that the object-sided features (being and unity) must also be subjectivised. These are always present in empirical experience and are not fundamentally altered whenever a paradigm shift occurs, even though they are admittedly commixed with the invented product of an act of conceptualization.[43]

One way of thinking about my brand of Kuhnian idealism is to understand it as analogous to Aristotelian hylomorphism. According to Aristotle, matter is an undifferentiated principle that underlies all physical reality. It is both metaphysically and logically prior to the physical reality that it underlies, though it is not conceivable in its own right.[44] On my view, the being and unity of an object function like matter. Just as empirical reality cannot exist without metaphysical matter, so a subject-sided world cannot exist without the object-sided moment constituted by the features being and unity. Scientific concepts are like non-necessary appendages to this object-sided experience which function as a sort of accidental form; and the result is a subject-sided world. Of course, my rendering involves some clear divergences from the Aristotelian rendition of these principles. For him, matter never exists in a non-informed state. But I deny that the object-sided world *must be* conceptualized. Likewise, the formal elements in Aristotelian hylomorphism are natural. But the structures born in Kuhnian conceptualization clearly are not.

Perhaps another illustration would help. In *Structure*, Kuhn uses a powerful metaphor for describing his view of paradigm-shifts which involves the famous duck-rabbit picture, and the

[43]Paul Hoyningen-Huene has described such circumstances by identifying the object-sided and subject-sided features as specific moments of a single, unified experience: "As Kuhn has noted so clearly … the genetically object-sided and genetically subject-sided moments of a phenomenal world are not properly separable." *Reconstructing Scientific Revolutions: Thomas S. Kuhn's Philosophy of Science* (Chicago: University of Chicago Press, 1993), 64. That the subject-sided and object-sided features of experience are inseparable does not entail that experience is not constituted by metaphysically distinct constituents.

[44]I use 'conceivable' here as a term contrastable with perceivable. Perception then would be experience of the object-sided features of reality, being and unity, whereas conception would be experience of the subject-sided features of reality.

notion of a gestalt switch. His focus there was on the impossibility of seeing the picture as both a duck and a rabbit at the same time. In order to see them both, one had to alternate back and forth between each characterization. I would like to focus on another aspect of the drawing, the ink itself. It is a fundamental assumption of the original illustration that the ink remains unchanged under each of the distinct conceptualizations. In this sense, it satisfactorily exemplifies the object-sided principle, the natural yet transcendental features of experienced reality. Whatever descriptive account of the picture's formal structure is given, it is object-sidedly supported by the ink's own natural and pervasive presence, its being and unity. Whatever conceptualizations are attempted, they are unable to alter these features of the ink. All conceptualizations are restricted by it and are unable to escape its authority. The object-sided world similarly places real limits on subject-sided developments. Thus, it is beyond question that, at least in this important sense, my take on Kuhn is realist. In closing, I present Kuukkanen's wonderful summary of Kuhnian realism:

> He was inclined to accept what might be called 'fig-leaf realism,' according to which something exists independently of the mental although we may not be able to specify what and in what form. Kuhn described himself as an 'unregenerate realist.' He also implied that nature undermines the security of the professional community, that nature has a role to play in shaping our conceptions, that the world 'places rigid constraints,' and that the role of nature cannot be left out of the explanations of science.[45]

Hence, if this characterization is satisfactory, I think it is now clear how my view avoids the devolution into an antirealist form of total-relativism.

4.IV IS THIS STILL IDEALISM?

One might wonder at this point whether the tethering of the object-sided and subject-sided worlds results in a reduction of my Kuhnian picture of reality into a single world – thus

[45]Jouni-Matti Kuukkanen (2009), 330.

entailing a denial of the non-externality thesis that is necessary in order to identify the Kuhnian doctrine as an idealism. This inference seems to be substantiated by the fact that Howard Sankey, a fervent critic of the Kuhnian idealism advocated by Hoyningen-Huene (and developed in the present work) has identified his understanding of reality as something quite like the one I have been describing: "Given that phenomena in different phenomenal worlds may be constituted of the very same objective elements, scientists working in such different worlds may nevertheless refer to the same objective entities."[46] He goes on to describe how a position such as "ours" ought to be described in a non-idealistic manner:

> Rather than speak of phenomenal worlds and an inaccessible world-in-itself, one may simply say that there is one world about which different folks believe different things. Far better to say, as I do, that the vocabulary of semantically variant theories may refer, by way of causal links, to the same mind-independent objects, though these same objects may be categorized in different ways by different theories.[47]

In response, I explain why I continue to promote the claim that the Kuhnian view is idealistic.

What is needed is an explanation of why one should treat subject-sided worlds as exemplifying a form of externality – why they should be cast as worlds at all rather than simply the categorical aspect of an otherwise object-sided experience. In short, I need to give a reason for why one should continue to think of subject-sided worlds as real in a sense relevant to the idealism thesis. In order to provide this, I first make the case that the subject-sided worlds are distinguishable from one another on the basis of their metaphysical properties (that they are clearly ontological in an important sense). Then, I argue that subject-sided worlds should be recognized as ontologically distinct from the object-sided world on the basis of something like

[46]Howard Sankey, "Howard Sankey, "Incommensurability: The Current State of Play," 23. This article is also found in *Theoria* 12. 425-445. My pagination refers to the version found at http://philpapers.org/rec/SANITC-2.
[47]Ibid., 24.

the infamous Indiscernibility of Identicals principal. Establishing these two points should be enough to sustain the *reasonability* of my idealism conviction.[48]

4.IV.A Subject-Sided Worlds are Ontological

Subject-sided worlds, in general, should be treated as ontological and not as *merely* conceptual. This is because subject-sided worlds have the ability to causally influence the people who experience them. They do this by influencing the perceiver's psychological states in two ways: first, with regard to what is actively believed, and second with regard to what is actively disbelieved. In fact, each subject-sided world has its own unique set of causal belief-making powers. Therefore, each subject sided-world should be distinguished from each of the others on ontological grounds. In order to support both of these aspects of my thesis, I offer an admittedly oversimplified example concerning the modern disagreement between proponents of Darwinian evolution and non-Darwinian intelligent-design (ID) theorists.[49]

Let's suppose that the object-sided world uniformly communicates itself to evolutionists and ID theorists alike, in accordance with the description of transcendental realism given above. Nonetheless, after conceptualization occurs these adversaries find themselves to hold notably distinct conceptual structures which, in turn, lead to the establishment and promotion of unique subject-sided worlds. At least part of the distinctiveness between the subject-sided worlds has to do with the content of what is actually seen by one operating within that world. For example, when one favoring the design hypothesis looks at the complex structure of a living organism, he claims to *see* a kind of specificity in the arrangement of the organism that is sometimes characterized as "irreducible complexity." Now, and this is the important part, when he perceives

[48]My aim to sustain the reasonability, rather than the necessity, of my conviction is an important qualification since I do not assume that this view is empirically or rationally demanded.
[49]Though it is oversimplified, I do not think it to be inaccurate with respect to the features that concern me here.

those same "irreducible" features in other organisms, his prior conviction (that the organic structures could not have been the result of a non-intelligent evolutionary process, but, rather, must have been a product of intentional arrangement) is strengthened. In short, the subject-sided world which, admittedly, is partly his own production, is recognized as having an ability to influence his psychological states (he now has an increased confidence in ID and increased doubt in the theory of evolution). Likewise, when the evolutionist perceives the remarkable similarity between the genetic structures of organisms from distinct species, he concludes that the organisms have a similar ancestral history. As he perceives additional similarities, his confidence in the theory of evolution increases and he becomes more skeptical of the design hypothesis. In both cases, the scientist's subject-sided world influences his psychological states.

In fact, not only is one's subject-sided world causally efficacious insofar as it increases one's confidence in previously held beliefs, but it also has the ability to prevent one from seeing how reality might be otherwise interpreted. For example, ID theorists seem not to be able to appreciate the connection between the structural similarity of genetic material and the common descent thesis, and the evolutionists seem not to see the irreducibility amongst the complexity. Examples can be easily multiplied. For instance, an ID theorist is unable to see biogeography as favoring an evolutionary theory and an evolutionist is unable to see the Cambrian explosion as favoring a design thesis. Nonetheless, when one hears an ID theorist discussing the Cambrian explosion, or an evolutionist discussing biogeography, one would think that the case for either view ought to be immediately recognized as conclusively decided by anyone who purports to be a rational and scientific thinker.

Therefore, unless it is determined that one or the other of the interlocutors is simply being intellectually dishonest, it would seem that circumstances of this kind support the claim that I am

making, that distinct subject-sided worlds have distinct causal efficacy. And because having a causal power is an ontological property, subject-sided worlds are properly considered ontological in an important sense. But this in itself is not enough to consider them as metaphysically distinct from the object-sided world in such a way that demands two forms of reference (as characterized in §3.II.B). For perhaps the subject-sided worlds can be reduced to the object-sided world in the relevant way so as to establish their fundamental identity. Below, I argue that they cannot.

4.IV.B Subject-Sided and Object-Sided Reality are Ontologically Discernible

I must concede that the object-sided world is directly responsible for many of the aspects of any subject-sided representation of it. For example, the being and unity of the object-sided world underlie what is interpreted as either a non-evolved product of intelligent design or as a non-designed product of evolution. Therefore, it is right to construe the object-sided world as being the cause of the distinct subject-sided responses to it. As such, it might seem that there is no legitimate ontological distinction to be made between the object-sided world and subject-sided interpretations of it. For one might contend that each is simply a perspectival representation of the underlying object-sided reality. I want to fend off such a view. I do so by focusing on the non-passivity of the perceiver involved in a subject-sided perceptual experience.

It seems to me that there are two ways in which something can be said to be in potency to an effect: actively or passively. When something is in a state of passive potency to an effect, it lacks the proper circumstances for the effect to come about without lacking an internal capacity to receive it were those circumstances to occur. In addition, it lacks an ability to stop the effect were the conditions to arise. Thus, under appropriate circumstances some effects occur with natural necessity. For example, on a clear day, an uncovered copper lightning rod atop a tall building is in passive potency to the effect of conducting a significant surge of electricity. No

alteration of its internal state must occur for the potentiality to become actualized. All that is required is a well-placed thunderstorm that produces a direct lightning strike. What's more, there is nothing that the lightning rod could do to prevent its being a conduit for the surge were these conditions to arise. It must simply endure the inevitable.

On the contrary, some things may be said to be in a state of active potency to an effect. When something is in a state of active potency, it is also lacking the circumstances to bring the effect about. Moreover, given the right conditions, no alteration of the object in active potency is needed to bring about the effect. However, in contrast with an object in passive potency, there is something that an object in a state of active potency can do in order to prevent the effect were the circumstances to arise. It could alter its own disposition in some relevant way so that the effect is precluded. For example, a maintenance worker leaning against the copper lightning rod on that same clear day would also be in potency to the effect of conducting a large surge of electrical current. Were the same well-placed thunderstorm and its lightning strike to occur, and were the maintenance worker to continue leaning against the lightning rod, inevitably he would receive a massive jolt of electricity. But in this case, it's not necessary that our worker is electrocuted, for he can change his status by moving away from the lightning rod. It can be said, then, that he is in a state of active, rather than merely passive, potency to being a conductor of a large surge of electricity.

Now, the ontological difference between being in a state of passive potency, as opposed to a state of active potency, is as follows. To be in a state of passive potency is to be disposed by nature to receive a certain action. For an object in passive potency, the reception of an effect cannot be avoided without also changing something else about that object. Thus, in order to avoid the effect, the lightning rod would have to either be shielded from direct contact with the

lightning strike or cease being copper. Neither alternative is possible without the help of an external agent (perhaps the maintenance worker in the first case and a clever alchemist in the second). Therefore, I contend that it is fundamental to an instance of passive potency that the object involved lacks an active power which could change its fate. On the other hand, to be in a state of active potency is to be disposed to receive a particular action, but not by nature. It is an accidental disposition that can be thwarted without changing either the external circumstances or the essential features of the recipient object. An actively potent object can simply reconfigure itself so that its fortune is altered. This was clearly the case for our maintenance worker who used his power of mobility to prevent electrocution.

So how does this distinction help? Sankey's interpretation of subject-sided reality as basically perspectival assumes that a perceiver is in a state of passive potency to the effect that the object-sided world has in store for it. In other words, in order for the object-sided world to be ontologically indistinct from the subject-sided worlds, one must assume that any perceiver can only have the exact subject-sided perceptions that she actually has in any given object-sided circumstance. This is the only way to attribute all the subject-sided causal power to the object-sided world. But if it is possible for a perceiver to experience distinct subject-sided worlds without the occurrence of a relevant corresponding change of object-sided circumstances (i.e., if a scientific gestalt-switch is really possible), then it would be reasonable to infer that at least some causal influence is generated in the subject-sided moment of the experience and, thus, that the causal influence of the object-sided aspect of the experience is, at times, indeterminate. In such a case, it would be said that the efficacious causal influence is the conceptualization itself and not the object-sided reality that is being conceptualized. Now, since being caused by something is an ontological property, and since a subject-sided world can be said to be caused by

x (the conceptualization) while the object-sided world is not caused by *x*, it should be inferred that a subject-sided world is ontologically distinct from the object-sided world in a meaningful sense. Hence, because subject-sided worlds are ontological and characterizable as external to a perceiver on the basis of their ability to causally influence one operating within them, it seems that holding a position that identifies them idealistically is appropriate.

Finally, it seems obvious that it is possible for someone to enter different subject-sided worlds without a corresponding change in the object-sided world; the possibility underlies the ability of a science-historian to put his metalinguistic lexicon to empirical use – to "experience" historio-scientific gestalt switches by "switching out" interpretive frameworks while considering a single set of empirical phenomena. Here is a quick supportive example. The Kuhnian historian can spend the day outside tracking the sun's apparent motion. But he has no trouble in switching back and forth between "seeing" the sun as a planet that orbits the Earth (thus identifying the sun as something that rises above a horizon in the morning and sets below the adjacent horizon in the evening) and "seeing" it as the center of our solar system (thus identifying the rising/setting part of the experience as a sort of situationally determined illusion). And, as Kuhn adamantly maintains, there is no need to postulate a corresponding change in either the actual motion of the objects involved or in the mechanical aspects of the perceptual process. The only thing needed to bring about such a change of interpretive experience is a decision on the part of the scientific-historian to apply a distinct set of concepts to the world of pure-observation, thus generating a pair of subject-sided worlds. Now that decision is clearly not forced by object-sided reality. Nor must a new object-sided causal force be introduced into the scenario for it to come about. It is simply a power possessed by the one who is enduring the pure-observational experience.[50] And

[50]Of course, this is not to say that external forces never lead to the original formulation of concepts that are intended to characterize the world. As many, including Kuhn, have pointed out, it seems that there is much to be said with

since this decision results in the development of the subject-sided worlds, it is the causal source of primary importance in the generation of subject-sided worlds.

4.V MY THESIS AND THE MYTH OF THE GIVEN

Now that I have completed the characterization of my position, there remains a concern worth addressing. That is, it may seem that my position is essentially a "sense-datum" view of science and, as such, that it falls victim to the infamous "givenness problem" that was identified by Wilfred Sellars.[51] In this section I briefly explain the nature of sense-datum theories and why my view seems to meet the criteria. Then I summarily describe Sellars' givenness problem. After this, I explain why I am not convinced that my position falls victim to the problem; namely I do not think that mine is really a sense-datum view. Finally, I acknowledge a manner in which I am willing to grant that my view is committed to a semblance of givenness, albeit one that does not ultimately saddle me with any uniquely problematic implications.

A sense-datum is a piece of phenomenological information that is received via the senses. Thus, if I claim to see a bowl of grapes in front of me, the sense data that I might claim to perceive would probably include a number of (seemingly individual) ovals and patches of purple or green. If I reached my hand into the bowl, I may add a number of additional data, for example smoothness and, if the grapes had been refrigerated, coolness. Finally, if I put one of the grapes in my mouth and begin chewing it, I may add crispness and sweetness to the stockpile of perceived data. Now, my view is certainly a form of empiricism. That is, the position that I am promoting is certainly committed to the claim that scientific knowledge is experientially-based.

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respect to the significant influence of social, political, and economic factors on scientific development. But these are clearly not determinative either since a person can experience a paradigm shift without leaving his social, political, or economic situation as well.

[51] Wilfred Sellars, "Empiricism and the Philosophy of Mind," in *Science, Perception and Reality* (London: Routledge & Kegan Paul, 1963, 127-196. I will use a method of in-text citation in this section.

As such, on first pass, it seems that my position could be appropriately characterized as a sense-datum view.

So what is the problem with sense-datum theories? According to Sellars, sense-datum theories distinguish between an act of awareness (i.e., seeing or sensing) and the "object" that one becomes aware of (e.g., the color patch or some other immediate sensible quality). The "object," he says, is postulated as the ground of givenness.

> The idea that observation 'strictly and properly so-called' is constituted by certain self-authenticating nonverbal episodes, the authority of which is transmitted to verbal and quasi-verbal performances when these performances are made 'in conformity with the semantical rules of the language,' is, of course, the heart of the Myth of the Given. For the given, in epistemological tradition, is what is taken by these self-authenticating episodes. (169)

But this idea of empiricism is problematic. As the ground of awareness, Sellars infers that the act of becoming aware of sensible "objects" either (a) does not constitute knowledge in the normal sense of the term since what is experienced in such an act is "a particular" and not "a fact" (128), or (b) the givenness is presumed to be a distinct form of knowledge – "a fact which presupposes no learning, no forming of associations, no setting up of stimulus-response connections" (131). In other words, the sense-datum theorist

> construes as *data* the particulars and arrays of particulars which he has come to be able to observe, and believes them to be antecedent objects of knowledge which have somehow been in the framework from the beginning. It is in the very act of *taking* that he speaks of the *given*. (195)

Generally, sense-datum theorists take path (b). However, Sellars argues that each of the paths is fundamentally problematic. Concerning (a), if the given object is not known, then it is unclear how the information can be inferentially related to the knowledge that it is supposed to ground:

> To suppose that the non-inferential knowledge on which our world picture rests consists of such ostensible seeings, hearings, etc., as happen to be veridical is to place empirical knowledge on too precarious a footing -- indeed, to open the door to skepticism by making a mockery of the word knowledge in the phrase 'empirical knowledge.' (133)

On the other hand, if ostensible experience is a distinct form of knowledge, then a severe inconsistency results. I will not make any effort to explain the inconsistency here since it is complicated and I have no inclination to argue against it. Suffice it to say that I am in willing to grant Sellars' assessment of (b)-path sense-datum theories and the problem of givenness.

So how can I evade the claim that my position is subject to the givenness problem? I do so by contending that my position is not actually a sense-datum view. For one, sense datum theorists seem to assume that "seeing" and "sensing" are virtually the same activity. But I reject this assumption. I conceive of "seeing" as having an unconceptualized phenomenological experience in the broadest sense. This is the action that happens in the pure-observational stage of cognition on my view and results in the perception of being and unity. In other words, one sees the object-sided world. "Sensing," on the other hand, I conceive of as seeing-under-a-determinate-set-of-concepts, namely those appropriate to observation *via the five senses*. Thus, "sensing" occurs by way of the phenomenological experience of such qualities as "red," "hard," "loud," "sweet," or "rancid." These concepts, I maintain, are post-conceptual. As such, a sensed world is a subject-sided world.

Now, I am willing to grant that "seeing" seems to occur via sensible experience since all of our "seeing" is accompanied by visual, tactile, auditory, gustatory, or olfactory experience. In fact, I tend to envision "extensionality" as the primary mode through which being and unity are communicated to the pure-observer, so it is quite natural to associate seeing with visual or tactual information. Hence, I understand the inclination to collapse the distinction between seeing and sensing. However, I wish to make a qualifying point that serves as a reason to avoid collapsing these cognitive activities into a single type. The proper objects of "seeing," as I have construed it, are being and unity; and these features of experience are not the proper objects of any of the

senses taken in themselves. Rather, the proper objects of sight, hearing, tasting, smelling, and feeling are color/shape, sound, flavor, odor, and solidity, respectively. As far as I can tell, while being and unity may be necessary characteristics of any experience of these sensible qualities, it does not seem appropriate to identify those characteristics with any of the qualities. Therefore, it does not seem unreasonable to consider the act of seeing as non-sensible in some significant way. Now, at first, this account might seem somewhat strange. Do I reject the belief that object-sided reality is fundamentally qualitative? Am I committing myself to the view that sense qualities such as particular colors or determinate shapes are not part of the world? No, I do not. But neither do I affirm that they are. In general, I wish to remain open-minded on these matters since I see no necessity that my ontology run that deep. I find it satisfying enough to commit only to the claim that object-sided empirical objects are surficial.

Another way of explaining my divergence from traditional sense-datum empiricism is by noting that I deny the standard sense-datist assumption that "being red or triangular" is logically prior to "seeming red or triangular." Instead, I hold a pair of more tempered beliefs concerning logical priority. First, I maintain that "seeming similar to things that I call red or triangular" is logically prior to "seeming red or triangular." But this is a mere psychological fact and is unimportant with respect to my stance on the givenness problem. Second, and more importantly, I maintain that "being extended" is logically prior to "seeming red or triangular." Beyond this, I intend to commit to the view that nothing about the exact qualitative character of the object-sided world can be inferred on the basis of these seemings.

In fact, there is another way in which my position is importantly distinct from sense-datum views. I wholeheartedly reject the inclination to uphold epistemic foundationalism. That is, what happens in my pure-observation stage has nothing at all to do with serving as a

foundation for inferential knowledge. Instead, what happens there is essentially a mere occasion for attempting science. And since Kuhnian science, as I have argued, is not an endeavor to establish object-sided truth, then there is no immediate concern to establish the foundations for object-sided knowledge by way of qualitative perception.[52] Thus, one might say that I adopt a version of Sellars "path (a)" (see above) since I maintain that "becoming aware of sensible 'objects' does not constitute knowledge in the normal sense of the term since what is experienced in such an act is 'a particular' and not 'a fact.'"[53] Now, recall that Sellars' challenge to path-(a) was to argue that this puts empirical knowledge on too precarious a footing to be deemed an acceptable path. I agree with him that empirical knowledge, which I understand to be a post-taxonomic category, becomes precarious at this point. But I see no reason to find this unacceptable, especially given the historical reality of revolutions. In my mind, such events have evidenced the inference that empirical knowledge *just is* precarious. Therefore, given that there is reason to believe that both (i) I am not a sense-datum empiricist, and (ii) the likely challenge to the path that I have taken is not persuasive, I find it unconvincing that my position is prone to Sellars' Myth of the Given, or at least it is not problematically so.

Of course, I do not deny that there are givenness assumptions which underlie my view. For my position rests on the assumptions that the feeling of being encountered by something and the feeling that the encountering-something is distinguishable from other possible-encountering-things is enough to suppose that there really is a something-encountered and that it really is distinguishable from other possible-encountering-things. I admit that I have no *rational* ground for taking these assumptions to be true and that it is not an empirically necessary belief. That is, I

[52]Ironically, Sellars seems not to have a problem with this sort of view: "For empirical knowledge, like its sophisticated extension, science, is rational, not because it has a foundation but because it is a self-correcting enterprise which can put any claim in jeopardy, though not all at once." (170)
[53]Of course, I will replace "a particular" with "a distinguishable" in order to avoid to strong a metaphysical claim.

find the Cartesian skeptic to be within his epistemic rights in wondering whether our most basic experiences, for me the experiences of being and unity, are really just systematic delusions. However, the skepticism problem does not seem to be uniquely problematic for my view. In fact, it seems uncontroversial in the context of scientific history that such givenness assumptions have been adopted by everyone. That is, no one of any prominence has ever tried to explain the heliocentric revolution by calling the reality of the existence of the object that had been identified as "the sun" into question. Rather, it seems to have been unanimously accepted that, even though the Ptolemaic view has been rejected, the existent that was identified as the sun on the geocentric view persisted through the revolution.

In summary, while Sellars characterizes his own project as "a myth to kill a myth" (195), I might be considered as providing my own myth. My myth acknowledges a pair of myths, one to be killed and the other to be retained. First, there is the myth in the givenness of conceptual content. I think that this myth ought to be killed; for if we do not allow that our scientific concepts might be rejectable objects of fancy, then we might find ourselves in a position of dogmatism that prevents changes that can result in a more extensive control of nature and, thus, perhaps in a better human experience. In short, this first myth has real detrimental implications. Now, I do not think that this attitude towards conceptual alteration could have been established *a priori*. That is, I do not fault the original dogmatic empiricists for staunchly defending their views as they did not see the way that mind-change could lead to technological advance; and I don't believe that there was any way to predict that it would. For these ancient empiricists, science was thought to be ordered towards truth, not utility. Only after their positions became exposed as untruthful, and the alternative theories proved not only to be more consistent with experience but also more conducive to productivity, would it become apparent that the scientific

enterprise had productive-value as well. Secondly, my new myth acknowledges the myth of the givenness of transcendental content – of being and unity. While the philosopher in me necessitates that I acknowledge this myth in theory, I see no good reason to think the transcendental myth should be avoided. That is, I think that attempting to avoid this myth is a bottomless philosophical pit that results in the severest form of skepticism – an inescapable pit indeed. And, while severe skepticism is a philosophically respectable position, I find it existentially horrid, and so I have decided that it is not worthy of serious commitment.

4.VI CONCLUSION

If the ontological and cognitional stories I have told here are coherent and able to be mapped onto our experience of the world, then I think that the Kuhnian account I have been developing is best characterized as transcendentally realistic and metaphysically idealistic. Thus, having shown that there is a viable interpretation of reality consistent with Kuhn's understanding of incommensurability and scientific disagreement, I turn my attention to the application of the theory to a real-world scenario. The following chapters substantiate my claim that Kuhnian incommensurability is a solid explanation for the disagreement between Aristotle and Newton on the question of void's existence. In Chapter Five, I present Aristotle's case that there is no void. In Chapter Six, I present Newton's case that there is void. In Chapter Seven, I show that the disagreement hinges on their distinctive subject-sided characterizations of the world.

CHAPTER FIVE:
ARISTOTLE'S CASE AGAINST VOID

Aristotle denies that there exists any region that should be construed as void – as a place where no physical material is present. Rather, he holds that all places should be construed as *completely full* of physical material. That is, the universe is a spatial plenum. In this chapter, I present and explain Aristotle's arguments against the possibility of void. The position expressed here is primarily based upon his account in *Physics*, but I supplement with other works when doing so is helpful. First, I characterize Aristotle's conception of void and the reasons his predecessors are said to have offered in favor of a belief in void's existence.[1] Then I present and explain Aristotle's responses to those reasons.[2] After this, I identify the most fundamental reason for Aristotle's denial of void, namely his belief that the common conception of void seems to be incoherent.[3] Finally, I close by describing Aristotle's space-filling substance, aether.

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[1]Aristotle primarily has in mind the ancient atomists, Leucippus and Democritus, as well as a few other classical philosophers (see *Physics* 188[a]19-23, *On the Heavens* 275[b]30-276[a]1, *On Melissus, Xenophanes, and Gorgias* 976[b]1-35, and *Metaphysics* 985[b]5-10). For a detailed explanation of Aristotle's concerns with atomism as a general theory, see Pieter Sjoerd Hasper's "Aristotle's Diagnosis of Atomism," in *Apeiron* 39.2 (2006), 121-156.

[2]One might think that it would be better to start with a positive account concerning the existence of aether and then to proceed to the negative account concerning void. However, to follow such an order would not quite capture the way that Aristotle views the matter. His positive account of the plenum is quite vague and his negative account of the void is much more explicit. This is evident when one considers the extent to which Aristotle discusses both of these subjects not only in *Physics* but even in his entire corpus: in *Physics*, the term 'void' arises 120 times, while 'plenum,' 'aether,' 'ether,' and 'ethereal' in conjunction only arise three times. In fact, in his entire corpus, the latter group of terms receive a total of only 46 mentions. I take it that this is a result of the non-existence of an ideal epistemic situation with respect to aether since it only resides in the outer spheres. This will be detailed below.

[3]In "Aristotle's Horror Vacui" (*Canadian Journal of Philosophy* 20.2, 1990), John Thorpe identifies the common view (c.f., Friedrich Solmsen, *Aristotle's System of the Physical World*, 135) that Aristotle "never argues directly that the void does not or cannot exist" but rather "contents himself with criticizing the arguments that other thinkers had advanced in its favour" (149). He adds that most modern commentators think Aristotle's criticisms are "heavily bound up with Aristotle's peculiar views about the phenomena and laws of motion" (ibid., 150). Thorpe goes on to challenge the critics, arguing that it is not the laws of motion that establish the grounds of argumentation for the Aristotelianism, but the concept of matter. I also think that the critics are wrong, but I think its because they ignore the data underlying my fifth category of argumentation below. I think my approach is more pure because the dialectic can be immediately grounded in the context of *Physics* whereas Thorpe's, admittedly (ibid., 159), cannot.

I am not concerned here with the task of critically evaluating Aristotle's arguments, except insofar as critical evaluation will help to make the present account clearer.[4] My aim is simply to show that Aristotle's position is both well considered and, for the most part, consistent. Thus, even if the reader finds Aristotle's view to be unpalatable for some empirical reason, so long as she considers it fairly respectable for a person with the evidence and tools at Aristotle's disposal, I will be pleased with the result.

5.I ARGUMENTS IN FAVOR OF VOID?[5]

Before asking whether or not void exists it is necessary to define the term. Aristotle gives a definition in *Physics* IV: "void is thought to be a place with nothing in it" ($213^{b}.32$).[6] In saying that "nothing" is in the place, one should take Aristotle to mean that no *material* stuff is present.[7] Hence, even if one were to postulate the presence of an immaterial object in a place that is materially empty, Aristotle would identify this as an instance of void. In contrast, a place that is full of material stuff, whether substantial or a non-substantial-material-substratum, is non-void, and is sometimes referred to as a plenum.[8] Now that "void" has been characterized, let's consider why someone might be inclined to suppose its existence.

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[4]So it may, at times, seem that I overlook serious problems with the argumentation. Rest assured that I do recognize issues with many of the arguments identified. These are addressed explicitly in §7.I.

[5]There is a sense in which this question already introduces an oversimplification of Aristotle's anti-void doctrine for, as Thorpe explains, Aristotle considers a few different possible characterizations of void in *Physics*: Potential, Interatomic, and Void Beyond the World (see "Aristotle's Horror Vacui," 152, n.12). I don't think that *one's ability to understand* Aristotle's view is limited by ignoring this distinction for now, and so I don't make use of it here (I do indirectly consider the distinction in §5.II.D, when I contrast separable and inseparable void). Nonetheless, perhaps having an understanding of the varieties of void would lead to having *a deeper respect for* the position.

[6]All in-text pagination in §5.I will be of *Physics*, unless specifically mentioned.

[7]I use only the ultra-general term "stuff" here so as to avoid the more determined notion of substance. This is because there is some disagreement in the interpretive literature as to whether the elements constitute substances or if they are something less than substantial. Whatever one's answer to this question might be, all would agree that, in the least, the elements are physical stuff.

[8]I do not have in mind here the material existence of prime matter, since Aristotle seems to think of the idea of uninformed matter as merely conceptual. Rather, I have in mind the possibility of some less-than-substantial yet informed matter. See the previous footnote for why I make room for such contents.

Aristotle gives a number of reasons that one might offer in favor of void's existence. Before considering these, let me identify one very simple argument that is easily overcome. One could attempt to substantiate belief in void with the following general empirical argument:

(P1) All bodies are said to be in a place.
(P2) There are some places in which there are no bodies – or better, there are intervals which lie between bodies.
(C) So void exists, since void just is a place where there is no body.

Of course, nearly everyone would admit at least that there *seem to be* places between solid bodies in both the terrestrial and heavenly realms. That is, the way the sky looks at night is exactly what one might expect to see if outer space were a vast, empty expanse with a few luminous bodies scattered about. However, most would also admit that one's mere phenomenal experience does not always account for the presence of subtler matter; for example, who would claim to see the terrestrial air on a calm and dry afternoon? Since it is admittedly acceptable to postulate the presence of air in such circumstances, there is no immediate reason to accept the claim that there must be void wherever a spatial interval between bodies is perceived. Thus, sensible perception alone cannot be used to discredit the theory that space is a material plenum, as postulated by Aristotle (Anaxagoras, Descartes, etc.).[9] Therefore, in order to be more convincing, the denial of a plenum should be developed on firmer epistemic ground.

Accordingly, many of Aristotle's predecessors offered *a priori* arguments in favor of the existence of void. Many of these arguments identify void as a physical precondition for well-established empirical phenomena. For example, some ask "How are we to explain local motion if not by postulating void?" (200^{b}20-21). On this approach, void is usually represented not only as

[9]For testimony concerning Anaxagoras' agreement, see *On Melissus, Xenophanes, and Gorgias* 976^{b}20-24: "For Anaxagoras, who devoted his attention to this subject, and for whom it was not enough merely to declare that a void does not exist, declares that things which are, are in motion, although there is no void." For Descartes agreement, see *Le Monde* where he states that "All those spaces which people consider empty, where we perceive only air, are at least as full, and filled with the same matter, as the spaces where we perceive other bodies" (Rene Descartes, *Le Monde ou Traitè de la lumiére*, transl. and ed. by Michael Sean Mahoney (New York: Abaris Books, Inc., 1979), 27.

a place that is empty with respect to material being, but also as a place that is *capable of the reception* of such being. On the contrary, a place with a body present is thought not to be capable of the reception of another material being. Likewise, it is common to consider the location where a material being resides as capable of *becoming* void if that place were abandoned by the material being, and thus as becoming capable of the reception of a body. In either case, without the presence of void somewhere in the universe, material being would be unable to change positions because it would be impeded by the objects that surround it.

A nice mechanical analogue is the classic children's game that starts off as a scrambled picture constituted by a number of individual painted squares, each of identical size, which are in clearly inappropriate relationships to one another. The object of the game is to alter the position of each square, without removing it from the containing frame, until the picture is unscrambled. Now, the movement of the pieces would be impossible if there was not at least one empty place at least equal to the size of one square, for each piece would be hemmed in by those surrounding it. Likewise, the possibility for motion in the real world requires the presence of an empty place. Hence, if one admits local motion, so the argument goes, one must also admit the reality of void.

Similarly, some took void to be a necessary postulate for the task of explaining varieties of both qualitative change (e.g., expansion, contraction, compression) and quantitative change (e.g., growth, diminishment). Arguments expressing these concerns are similar to those offered in favor of void as a precondition of local motion – e.g., something cannot expand or grow unless there were an empty place to expand or grow *into*. I give detailed examples of this in §5.II.D.

For Aristotle, local, qualitative, and quantitative change are the only relevant kinds of strictly physical change that a material being can undergo.[10] Thus, if the void theorist is correct,

[10]Aristotle also considers metaphysical change, an exchange of form in a given chunk of matter as motion. However, it is clearly a distinct sort of phenomena than the void theorist is concerned with, and so I do not dwell on it here.

then an instance of strictly physical change requires the presence of void. Despite the arguments in favor of void's existence, Aristotle believes that something has gone awry. In §5.II.A-§5.II.D, I consider his response to each of these lines of pro-void argumentation. It will become clear that he takes each argument to be problematic because either it leads to an undesirable consequence or it does not sufficiently support an unqualified affirmation of the existence of void. In §5.II.E, I consider the claim that "existent void" is conceptually incongruous.

5.II ARGUMENTS AGAINST VOID

In *Physics* IV, Aristotle develops a number of arguments against the existence of void. I group these into five categories.[11] The first three categories involve empirical arguments related to local motion: (1) natural motion, (2) imputed motion, and (3) relative velocity. The fourth category involves empirical arguments concerned with qualitative and quantitative change.[12] The fifth category includes a non-empirical argument concerning the nature of place.

5.II.A Concerning the Natural Local Motion of Things

The first of Aristotle's responsive arguments concerning local motion takes seriously the idea that some motions of material objects result from a natural inclination to move in a certain direction. Such inclinations are caused by an internal natural principle (for Aristotle, a form). Thus, these motions are aptly identified as natural motions. Natural motion stands in contrast with unnatural motion (violent or compulsory motion). An unnatural motion is one where a material object moves contrary to its natural tendency. For Aristotle, unnatural motion could

[11]The arguments presented in §5.II.A-D are abstracted from *Physics* $214^{a}4$-$217^{b}28$, though their explication usually involve considerations addressed elsewhere by Aristotle. I supply references to such considerations for further study where possible. The content in the §5.II.E is abstracted from *Physics* IV, $209^{a}31$-$213^{a}10$.

[12]A critique of pro-void arguments from quantitative change is noticeably absent from Aristotle's account. However, it is easy to develop one on Aristotle's behalf. I offer one in §5.II.D.

never take over as the primary motive disposition of a material object. In this sub-section I consider how Aristotle's commitment to natural motion leads him to reject void's existence.

The primary argument in support of natural motion is an empirical one: natural objects exemplify a disposition to move in a particular direction. James McCue explains the assumption underlying the assertion: "because nature is the principle which regulates activity from within a being we can argue to nature from an empirically given regular activity which has no external source."[13] In other words, "if we find that something happens in a certain way always or for the most part, we can reason validly to some nature as cause."[14] Some common examples of natural motion are the motion of fire, which always moves away from earth's center when unimpeded by an overriding force, and the motion of earthy matter, which always moves towards earth's center when unimpeded by an overriding force.[15] That Aristotle uses these as his examples is significant since, according to the beliefs of many Greek empiricists, they are two of the four fundamental elements out of which the entire material universe is composed.[16] In fact, on Aristotle's account, the other two, air and water, are often taken to be less object-oriented than fire and earth.[17] As such, every material object in the sublunary realm, according to Aristotle, is said to have a significant amount of earth and/or fire in its constitution. Thus, since earth and fire have intrinsic

[13]James McCue, "Scientific Procedure in Aristotle's De Caelo," in *Traditio* 18 (1962), 6.
[14]ibid.
[15]See *On the Heavens* $268^{b}21$-24.
[16]Though this theory may seem naïve to moderns, we would be shortsighted not to seek a charitable understanding of the view given that, as James Longrigg explains, "the four-element theory has been one of, if not the most, durable and influential scientific paradigms in the history of Western science" ("Elementary Physics in the Lyceum and Stoa," in *Isis* 66.2 (1975), 212). Empedocles was the first to openly identify the so-called "four roots" (fire, earth, air, and water) and to maintain their equality with regard to primacy. Anaxagoras followed him. So did Aristotle (who added a fifth element, aether) and most of his followers through the sixteenth century. The Stoics and their progeny also adopted this doctrine.
[17]They are often considered as either the main constituents of the mediums through which earthy or fiery objects traverse or as a secondary class of elements. Consider, for example the following statement from *On Generation and Corruption*: "The simple bodies, since they are four, fall into two pairs which belong to the two regions, each to each; for Fire and Air are forms of the body moving towards the limit, while Earth and Water are forms of the body which moves towards the centre. Fire and Earth, moreover, are extremes and purest; Water and Air, on the contrary, are intermediates and more combined" ($330^{b}31$-$331^{a}1$).

impulses to move in a particular direction, Aristotle infers that *every substantial material being* has a unique natural directionality in accordance with the ratio of earth and fire it contains.

Now, Aristotle holds that "all [local] movement is either compulsory or according to nature" (215^{a}.1-2). He also holds that void cannot actively contribute to either natural or compulsory movement. Thus, he infers, it is inappropriate to call void a "cause of motion" in any scientifically important sense. For one, void cannot be the immediate cause of natural movement since natural motion is an internally produced activity that is established by the presence of form in an object. And because void is, by definition, said to be distinct from the objects which are thought to be moving through it, it cannot be the cause in this (intrinsic) sense. Additionally, void cannot be a cause of compulsory motion since it is not a substance and all non-substances lack form. This follows because the form of an object is its active-power-source – it establishes in general what kinds of activities an object can take part in and, thus, how it is able to influence other objects. Therefore, in lacking form, void is incapable of acting at all, and thus cannot affect another object. Since to impose motion, by definition, is to act upon another, it then follows that void cannot be invoked to causally explain non-natural motion either.

So void can be the cause of neither natural nor compulsory motion. Since these are the only forms of local motion, void is thought irrelevant to local motion. *Of course, one may wonder why void is being considered as a necessary cause here rather than as a necessary condition*. That is, if void is taken as a necessary condition rather than a necessary cause, there is no need to consider any transference of active power. I think that this is what those with whom Aristotle disagrees had in mind. Nonetheless, he would not be moved as becomes clear in §5.II.B.[18]

[18]Aristotle does not overlook the fact that, for all practical purposes, void is treated as a condition. He reports that, for many, space, void, and time, "are thought to be necessary conditions of motion" (200b20-21). So he knows the

5.II.B Concerning Imputed Local Motion

The second responsive argument concerning local motion arises because of Aristotle's commitment to an impetus theory of motion.[19] Simply put, an impetus theory of motion upholds the idea that, in order for something to be locally moved, apart from its own active power, it needs to maintain constant contact with that from which it primarily derives its motion. In other words, within Aristotle's theoretical framework there will be no possibility for direct action at a distance. Now, unlike many Aristotelian doctrines, this one seems to go immediately counter to empirical intuition – e.g., an observation of a projectile in motion. Such objects clearly maintain local movement even after being separated from a projecting cause. But to challenge the view in this way is to misunderstand Aristotle's point. He does not deny that a projector is a real cause of projectile motion. Nor does he hold that a projector must remain an active cause in order for a projectile to keep moving. Rather, when an object is projected, there is a transfer of momentum from the projecting source to the projectile until the moment the object is released and, at this point, the original causal influence is no longer an influence on the activity. Instead, the material medium takes over as the primary factor in the projectile's imputed motion, as it literally "holds up" the projectile.

There are two general ways to understand the nature of the medium's causal power. First, it can be supposed that the suspension of a projectile occurs as a result of the mutual replacement of moved air. In such a scenario, some of the air is unmoved and functions as a shelf along which the projected item glides. However, the air that stands directly in the path of the projectile object is forced to move by the impetus of the projector; and this imputed motion leads to an unending

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distinction. He just doesn't seem to think that being a necessary condition has scientific value unless mechanical causality is involved.

[19]Technically, the derivation of the characterization of the impetus theory is attributable to later Aristotelian commentators (e.g., John Philoponus, Avicenna, Buridan) and not to Aristotle himself. Nonetheless, it seems easily inferable from the views openly expressed by Aristotle.

chain of further imputed motions. This chain of imputed motion extends to include even the air that is immediately behind the projectile. Thus, the air that is originally pushed along by the action of the projector ends up being a contributing factor to the continued push on the projectile itself. What's more, the imposition from the rear of the projectile will be instantaneous with the originating force (because space is a plenum).

The second way to construe the medium's causal power is as follows. The suspension and lateral movement of the projectile can be said to occur because the moving air transfers its own natural power of lateral-motion to the object, as if actively grabbing it and pulling it along. This scenario is distinguishable from the first because, in the first, the air is treated as if having no natural motion of its own, as if it were initially in a passive state to the projectile's motion. I take this second option to be more appropriately Aristotelian because it is seen to make use of the active power of the immediate cause, which is appropriate for a scientific explanation.[20]

Given this theory of motion, Aristotle sees two serious problems arising for an advocate of void. First, he thinks that it will be impossible to explain the projection of any object on a pro-void view since (i) void could not do any pushing or pulling since it lacks any formal basis for possessing and communicating causal force (see §5.II.A), and (ii) the mere presence of void necessarily rules out any appeal to any additional causal forces that could do the needed work. That is, if there really were a place with nothing in it, then there would be nothing present that could act as a mediating pusher or puller. So the projected object should simply reengage in its natural motion as soon as it is released by the projector. But this does not happen. Since there is no apparent alternative explanation for imputed motion, a commitment to void is not only

[20]Aristotle seems to affirm my understanding: "For air is both light and heavy, and thus qua light produces upward motion, being propelled and set in motion by the force, and qua heavy produces a downward motion. In either case the force transmits the movement to the body by first, as it were, tying it up in the air. That is why a body moved by constraint continues to move even when that which gave the impulse ceases to accompany it" (*On the Heavens*, $301^{b}23$-28).

without explanatory value, but, in fact, it implies an even greater explanatory gap than a plenum view.

Second, even if one allows for projectile motion through void (by temporarily disabling the natural tendency of the projectile), no obvious explanation could be offered as to why a thing should ever undergo a reduction of its momentum as it travels through void. As Aristotle notices, "a thing will either be at rest or must be moved *ad infinitum*, unless something more powerful gets in the way" (215^{a}.20-21). On Aristotle's plenum view, since the natural motion of a medium is involved in projectile motion, its presence can contribute to the diminishment of imputed motion.[21] But even if the power of an originating cause can, in some mysterious way, be retained by an object propelled through void, the *gradual reemergence* of the projectile's natural tendency to move in a certain direction will be seen to remain unexplained.[22] Therefore, Aristotle infers, void cannot explain either projectile motion or its tendency to stall.

In summary, void is not useful for explaining instances of imputed local motion. That is, the void theorist cannot explain either the continuance of imputed motion, once the originating cause has stopped being an immediate cause, or the gradual return of an object to its natural motive state. In either case, it is necessary to postulate another force that brings these empirically recognized phenomena about. *This is why postulating void as a necessary condition for motion is determined to be pointless on the Aristotelian account*. *It doesn't really explain anything*.

[21]For example, diminishment could occur when two distinct bodies constituted mostly by air, water, or aether are in contact but have different directional properties (left-to-right, right-to-left) or when the body is transferred from one medium to another that has a different rate of speed.

[22]The problem is not with the mere reemergence, for the void theorist can appeal to the form itself as the primary cause. The problem is in explaining why the reemergence does not occur all at once. The imposition of a medium can explain this, but this is not available to the pro-void theorist. Of course, the void theorist could push back on Aristotle and either deny natural motion or the diminishment of imputed motion in void regions.

5.II.C Concerning Relative Velocity

The third responsive argument concerning local motion against a pro-void view involves the claim that the existence of void is incompatible with the possibility of relatively distinct velocities. According to Aristotle:

> We see that bodies which have a greater impulse of either weight or of lightness, if they are alike in other respects, move faster over an equal space and in the ratio which their magnitudes bear to each other. Therefore, they will also move through the void with this ratio of speed. But that is impossible; for why should one move faster? (In moving through *plena* it must be so; for the greater divides them faster by its force. For a moving thing cleaves a medium either by its shape, or by the impulse which the body that is carried along or is projected possesses.) Therefore, all will possess equal velocity. But this is impossible (216^{a}.12-21).

On first pass, this is a confusing contention, and various commenters have argued that Aristotle commits some manner of a serious error here. For example, Thomas Aquinas, a regular defender of Aristotle, takes the philosopher to be saying that there is no way to determine the absolute speed of an object in motion in the void: "It must be realized that in the development of this argument there is a difficulty…. For the argument seems to suppose that there is no difference in the speed of motions except the difference of the division of the media."[23] Aquinas attempts to "correct" the supposed error: "granting motion through a void, it follows that there is no deceleration from the natural speed. But it does not follow that motion through a void has no proportion to motion through a plenum."[24] Others have offered distinct challenges to Aristotle's reasoning, though there is no need to go into the particular details here.[25]

Nonetheless, I think that Aristotle's reasoning can be made to appear acceptable if we take him to be referring to a specific context. Thus, in his defense, after identifying the primary

[23]Thomas Aquinas, *Commentary on Aristotle's* Physics, trans. by Blackwell, Spath, and Thirlkel (Notre Dame, IN: Dumb Ox Books, 1999), 260 [539].
[24]ibid., 258 [534]
[25] For additional examples of the concern with this argument in the medieval period, see Edward Grant, *Much Ado About Nothing: Theories of Space and Vacuum from the Middle Ages to the Scientific Revolution* (Cambridge: Cambridge University Press, 1981), Chapter 3.

features in play, I consider a material situation in which the argument seems to hold.[26] In short, I show that, given his initial set of assumptions, Aristotle's inference is not unsustainable (or at least not entirely so) in the right context.

First, let us consider the primary features of this argument. The weight or lightness of an object corresponds to the directional tendency of its motion, as is the case throughout *Physics*. A "greater impulse" with regard to directional tendency, then, has to do with the resoluteness of the object to reach its place of rest; this, unsurprisingly, can be characterized as an object's speed.[27] Now, an object's speed is determined by two factors. First, and fundamentally, speed is always at least partly determined by an object's elemental composition. Thus, the force of the downward impulse which belongs to a for-the-most-part-earthy object is a function of the contrasting natural pulls in distinct directions that are due to the inclusion of earth, air, water, and/or fire in its material composition. Second, the speed of an object is influenced violently by the character of the medium that stands between the object and its natural place. A material medium forcefully slows the motion of an object; the more dense the medium, the slower the object moves. In the absence of a medium, i.e., in the presence of void, there would be no violent influence.

From these starting points, then, we might reason that to dismiss the reality of a material medium and to replace it with void should not undo the possibility that there be objects moving at distinct speeds, for if a pair of objects have distinct compositional characteristics, those objects would still move at different rates. But, in Aristotle's context, such a qualification is undercut

[26]I must admit, I do not find immediate contextual support in this specific passage for the qualification that my interpretation depends upon. The passage uses a claim about ratios that I find difficult to fully appreciate. For what its worth, this is the feature of the argument that most commentators have appropriately focused on, and so rigorous scholarly treatment has occurred (albeit, to little avail for one who hopes for an acceptable defense of Aristotle). However, I think that the spirit of the argument can be made more palatable by importing Aristotle's concern to a specific, and entirely relevant, material context (as I give below).

[27]Speed is not taken in its full quantitative sense by Aristotle and any interpretation that looks beyond the qualitative assessment of faster/slower is probably digging to deep. For an elaboration on this point see Helen Lang, "Aristotle's *Physics* IV, 8: A Vexed Argument in the History of Ideas," in *Journal of the History of Ideas* 56.3 (1995), 366-369.

because, in his system, the objects which are perceived to be moving at different rates are alike in all respects other than their heaviness or lightness. I take this to entail compositional likeness. If this interpretation is granted, Aristotle's argument can be reformulated as follows:

(P1) If two objects have identical compositional character then they have identical natural heaviness or lightness.
(P2) If two objects have identical natural heaviness or lightness, then they must move at the same relative speed, unless impeded by mediums of distinct density.
(P3) If two objects are moving through void, then there can be no distinction of density in the medium.
(P4) Hence, if two objects have identical natural heaviness or lightness and are moving in a void, then they must move at the same relative speed.
(C) Therefore, if we find that two objects of identical compositional character are seen to be moving at distinct speeds, then it must be denied that they are moving through void.

In order for this argument to be completed, we need a pair of empirical premises: (1) we find two objects of identical compositional character that are said to be moving in a void, and (2) we are able to see that these objects are moving at distinct speeds. I think that both of these premises are obtainable under Aristotle's conception of nature.

First, Aristotle maintains that all of the heavenly bodies are constituted by pure aether.[28] Thus, whereas for composed objects in the terrestrial realm there can be a distinction of weight or lightness in virtue of the distinct compositions involved, in the extra-terrestrial realm there is no elemental composition and, hence, no ground for a distinction of weight or lightness.[29] Rather, the natural impulse of weight or lightness belonging to each individual heavenly body should be identical to the natural impulse of weight or lightness of any other because each heavenly body owes its natural weight to exactly the same principle.[30] What's more, heavenly bodies constitute the most likely objects to be identified as moving through void in the first

[28]This teaching is explained in §5.III below. For now, suffice it to say that Aristotle has an argument that the heavenly bodies cannot be constituted by a mixture of elements.
[29]Again, Aristotle is no Newtonian. An object's rate of motion has nothing to do with mass or distance from the center of an attracting body and has everything to do with its compositional character and that of the medium.
[30]Since all directional motion has but one principle, the form of the element that brings it about, neither mass nor the presence of a nearby object would have any role to play in the Aristotelian system.

place, thus these are the best objects to which we can direct our attention regarding this argument. Therefore, the first empirical premise is satisfied.

Additionally, Aristotle could contend that there are observed examples of such bodies that really do move at distinct speeds. For example, when one looks to the heavens, some of the luminescent bodies seem to make their full cycles at greater/lesser rates than others. Of course, most of these observations can be explained away as mere illusory appearances – the different rates being the result of a distinction in the relative distance of these bodies from an earthly observer. Thus, the planets appear to move at a greater rate than the stars because they move in a sphere that is nearer to the earth but, in truth, the actual rate of speed of these bodies (which is an effect due to the character of the composing material, aether) could be presumed to be identical without any uncomfortable empirical consequence.

However, there are some other circumstances that cannot be easily explained. For example, the sun and moon are believed to occupy distinct spheres, and so they are required to be at distinct distances from one another. Yet there is no noticeable difference in the time that they take to traverse the sky when they take a similar track. Modern thinkers recognize this to be easily explained by appealing to the fact that the rising and setting of the sun and moon are attributable not to the motion of those objects but to the axial rotation of the earth. But, such an explanation is not available to the static-earth geocentrist. Instead, the speed of lunar and solar motions had to be explained on the basis of their orbital progression. As a result, given that the bodies are implanted in distinct heavenly spheres, the only possible explanation for the apparent similarity of speed must be that these bodies move at really distinct speeds. But, since the composition of these bodies cannot be the factor that causes this distinction in the rates of speed,

since each is believed to be composed entirely of aether, there must be a distinction in the density of the medium.[31] [32]

5.II.D Concerning Qualitative and Quantitative Change

As previously mentioned, for Aristotle there are three ways in which material substances can change: in place, quality, or quantity. Having provided Aristotle's arguments that void is an unnecessary and sometimes problematic postulate concerning changes of place, I now consider the contention that qualitative and quantitative change do not require the existence of void. First, I clarify the difference between qualitative and quantitative change. Then, I provide a quick example of pro-void argumentation with respect to qualitative change before offering Aristotle's response to the argument. I repeat this approach for quantitative change. By the end of the section, it should be clear that the postulation of void is unnecessary for explaining either sort of change given Aristotle's view of nature.

The three primary kinds of qualitative change on the Aristotelian account are expansion, contraction, and compression. The reason that these are considered as qualitative, rather than as quantitative changes is that the amount of the material belonging to a substantial object in such

[31]Keep in mind that the "must be" is contextually determined here. Certainly, this is not thought a logical requirement. Neither is it a metaphysical or physical requirement. For example, one could tell a story where the distinct speeds of the sun and moon are based upon the distinct elemental compositions of these – varieties of aether if you may (it would have to be varieties of aether supposing that directionality of motion is a necessary condition to elemental distinction). In short, given the ontological apparatus in play, this "must" is appropriate only for Aristotle.

[32]My reasoning presented here may seem similar to that of Joseph Katz in his article "Aristotle on Velocity in the Void (Phys. D, 8, 216 a 20)." In that article, Katz argues that, for Aristotle, if one were to admit of void, then "variations in velocity can depend neither, as a matter of course, on the medium … nor on the body" (433), and so would go unexplained. Of course, I agree with this. However, I have taken a significantly distinct path in order to make this inference. Katz argues that Aristotle arrives at this by "avoiding the mistake of making the velocity of a body proportional to its weight" (434). On the other hand, I argue that he arrives at this conclusion *exactly because* he is committed to identifying velocity and weight with one another. Katz' then goes on to infer that Aristotle is actually an anticipator of Galileo's claim that velocity does not depend upon an object's weight. I think that this is wrong since I follow the traditional notion that weight and velocity are immediately correlated for Aristotle via the elemental forms. That said, I do find that Aristotle can be read as an anticipator to Galileo in another sense, namely that size is not directly correlated with the directional speed of an object. The reason Aristotle cannot be taken as anticipating Galileo in the other sense is that "weight" means something entirely different on a Galilean view; it is fundamentally tied up with the notion of gravitational attraction, which is absent in Aristotle's universe.

an event is not thought of as increasing or diminishing. Instead, when the qualitatively distinct state comes about, there is some other kind of alteration involved; most likely, the proportion of the substantial object's material to the total material present within a spatial region is modified.[33] Let me explain this further. Assume for the sake of argument that one could measure the quantity of the matter intrinsically present in a substantial object both before and after an instance of expansion.[34] Now let's assume the measurements turn out to be identical. Nonetheless, suppose that it is recognized that the substantial object now takes up a greater volume of place than it had at the previous time. This change can be expressed as an instance where an external material (i.e., free floating air or water), infiltrates the geometrical limits originally occupied by the now expanded substantial object, and so pushes its constitutive elements apart (without causing a destructive division). What's more, the infiltrating material is never absorbed by the substantial object, and so does not become a part of it. Thus, the total volume of the substantial object's constitutive parts does not increase. Only the volume of the place that it occupies does.

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[33]One can also make the case that the elemental bodies themselves expand without any real increase in proportion. Usually such change is described in the terms of coming under a new state, perhaps that of becoming hot or cold, moist or dry. I suppose that such changes are reducible to changes in environmental factors which are, ultimately, based upon the change in the presence of other elements such as fire and air for heat, earth and fire for dryness, earth and water for coldness, or water and air for moistness (*On Generation and Corruption,* 330^{b}3-5). Thus, proportion remains the distinguishing factor.

[34]We might find a practical problem for the Aristotelian account here. As I understand his view, one could never actually measure quantitative increase directly because the substantial form more-or-less masks the elemental forms as long as it is subsuming the elemental particles. Thus, one could not count the air particles subsumed under the human form because the air-forms "go into hiding." That is, the substantial form does not destroy the elemental forms, but rather pushes them into a state of active potentiality, where they will await their further opportunity to be made manifest when the substantial form is separated from the material substrate and the matter decays back into a heap of its constitutive elements. See *De Anima* 411^{b}8-9. This is certainly a strange process. For an interesting and informative read on the nuances of Aristotle's doctrine of the elements, in particular the semi-substantiality of the elements, see Robert Sokolowski's "Matter, Elements, and Substance in Aristotle," in *Journal of the History of Philosophy* 8.3 (1970), 263-88. I do not agree with Sokolowski's conclusion in the work, that the elements are not really substances but rather are fundamental powers of matter, for I understand Aristotle as being committed to the view that powers derive from form and that uninformed matter does not exist. If this is right, then neither powers nor matter can be metaphysically prior to substance, and so treating these as more fundamental is inappropriate. Sokolowski certainly seems to implicitly reject the attribution of my understanding to Aristotle by substantializing uninformed matter and identifying natural powers without a formal basis (c.f., 275-277 and 284ff). Nonetheless, even supposing Sokolowski misses the mark, there still seems to be something reasonable about attempting to distinguish between the elements and traditional substances such as a man, a horse, or a tree.

Similar stories can be told for instances of contraction and compression. For contraction, an intruding external material can be said to leave the spatial limits that it once co-occupied with a substantial object. So the substantial object seems to take up less geometrical room. For compression, an external material is directed towards the place occupied by a substantial object. But, for some reason, this material cannot get under the substantial object's surface. However, the external material can exert force on the object. Thus, it can get into the outer region of the original place occupied by the object in virtue of its ability to squeeze out other infiltrative, non-substantial material that had been residing in the interstitial regions of substantial object.

On the contrary, quantitative change occurs whenever a substantial object actually increases substantially. On Aristotle's view, an external material within the spatial limits of the substantial object is transformed by the object's form into a part of the object's total substance. For example, over the years, and to my chagrin, much of the pizza I have eaten has been formally transformed into fatty flesh rather than being purged as a vicious infiltrator ought to have been. The result is that my elemental measurements have increased during this period, and so I not only take up a greater volume of place, but I now have a greater volume of matter.

Having distinguished qualitative and quantitative change, I now explain how the reality of these activities is supposed to support void-theory, beginning with qualitative change. According to void theorists, in order to explain qualitative change, one must admit of void as present *within* an object. For, unless void were in the object to begin with (in the form of pores and interstitial regions), no external material could ever have found its way into an object to cause expansion or to have found its way out of an object to cause contraction. The inference is clearly related to the reasoning discussed above (concerning local motion) and for good reason since all qualitative change seems to be reducible to the locomotive activity of an external

material in relation to the dimensional character of the substantial object undergoing the alteration.

Aristotle's criticism of this argument involves catching the void-theorist in a dilemma. First, he asserts that there are just two ways a void theorist can maintain the presence of void in an object – in either a separable or an inseparable way. Then, he argues that void cannot be present in an object in either way. To show that void cannot be present in a separable way, he offers an argument that the equation of void and place are necessary on the separable void theory, and that this is deeply problematic. Since I address that issue in greater detail in §5.II.E, I prefer to pass over it here. Instead, I offer a distinct argument that void cannot exist within an object in a separable way. The argument I develop here is consistent with aspects of Aristotelian theory that are either (i) generally familiar, or (ii) have been explained in this chapter already.

To begin, suppose there is a substantial object with a separable void within it. To admit of the presence of separable void here seems to be nothing other than the affirmation that there is an empty region in the object – a hole. Now a hole is a privation and a privation is a "denial of a predicate to a determinate genus."[35] In other words, to call the hole a privation of something is to identify it as the contrary to that in which it persists. Since separable void is a privation of substance simpliciter, separable void is identified as non-substance.[36] Now, since separable void is postulated to explain alteration, Aristotle would require the critic to concede that void has mechanical causal power. For, the substantial object in which void is supposed to persist is presumed to be in potency to expansion or contraction. Being in potency, the substantial object lacks the active power that is needed to bring about the expansion or contraction. So the

[35]*Metaphysics* 1011^{b}19-20.
[36]Technically, if void is a privation of material substance, not substance simpliciter. But, as far as I can tell, Aristotle would not agree to the postulation of non-physical substances. This actually becomes a key point in the contrast with Newton. See Chapter 7.

explanation must invoke an external, mechanically efficacious cause. But, since void cannot have causal power (because it is not a substance and so has no form in which such power is seated), the idea of separable void in a substantial object is superfluous at best.

On the other hand, Aristotle considers it "less impossible" that there be inseparable void in an object ($216^{b}34$-35). He explains his concession here by allowing that inseparable void can be identified as an explanation for the degree of rarity in an object's composition, and, in turn, by allowing rarity to be used to explain natural upward movement.[37] Now something can be identified as a cause of this kind of motion only if it is continuous with the object (presumably because upward movement is natural, as opposed to compulsory, and because whatever is due to an object's nature must be continuous with it). Nonetheless, though Aristotle admits this position to be better, he finds it to be critically problematic. For, if void is in fact inseparable, then, when a rarified object moves upward, void does too. So if the void-theorist is to remain consistent, he must postulate meta-void.[38] Therefore, the void-as-inseparable view ends up being just as just as ontologically crowded as a plenum view, but with the added problem of having to empirically distinguish one kind of nothing from another kind of nothing – a monumental task indeed. Further, the problem cannot be resolved by denying the movement of void, as this would be to revert back to void-as-separable position, which has already been (presumably) undermined. Hence, void is not found to be a satisfactory explanation for the possibility of qualitative change.[39]

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[37]One may wonder about the distinction between being an explanation in this sense and in the sense I rejected in the previous paragraph. The reason that being an explanation in this case is not as problematic is that void need not be construed as an active cause, but merely as an occasional or material condition of sorts. This condition presumably leaves all of the truly causal activity up to the natural disposition of a substantial object. Hence, the lack of void would lead to other motive states, but not because void causes any motion on its own.

[38]Aristotle expresses a concern along these lines in *On the Heavens*: "if the void is to move, it must have a place out of which and into which the change carries it" ($309^{b}25$-26).

[39]A more serious problem related to the inseparable view is conveyed by Thorpe in his "Aristotle's Horror Vacui." Thorpe reminds us that "void is nothing" and then points out that "to talk about different tracts of void is to talk

Now I consider the claim that void is needed to explain quantitative change. The pro-void theorist could claim that, to explain quantitative growth, one must postulate an empty medium to receive the expanded dimensions of the previously smaller substantial object. And in order to explain diminishment, one must admit that, where there once was an extended segment of the substantial object under consideration, this segment no longer exists. Thus, void is needed on both accounts.

Can the Aristotelian view account for the reality of quantitative change without void? I think so since invoking his doctrine of metaphysical reorganization seems enough to explain the phenomena. As was explained earlier, things quantitatively grow whenever they are substantially conjoined with infiltrating material. This is the result of a very intimate process: a form-directed fusion event. Aristotle would describe this process leading to quantitative change as a complex act involving (1) the local motion of the objects to the same general region, and (2) the fusion of the objects. Void has already been found unnecessary for explaining (1). And there is no clear connection of (2) to the success of void-theory. Likewise, diminishment can be described as the opposing process, where a form metaphysically releases some of its formerly possessed matter. Again, I see no clear value in postulating void to explain this deeply metaphysical event. Thus, the occurrence of quantitative change is not clearly evidence for the existence of void.

5.II.E Void and the Nature of Place

Prior to this point, I have given Aristotle's challenges to the arguments for the existence of void. But undermining the arguments for void's existence is not sufficient for undermining the possibility of void. Rather, a positive anti-void argument is needed. Aristotle has one. Let's

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about different bits of nothing" (157). But, he contends, to do so is "surreptitiously to treat nothing as though it were something" (ibid). I wholeheartedly agree. In fact, the substance of the argument conveyed in §5.II.E makes essentially the same point though with more theoretical specificity.

consider what I take to be his fundamental challenge to void theory, the contention that void is incoherent because it involves treating "place" in a substantival manner.[40] [41] [42] In this section, I consider Aristotle's doctrine concerning the nature of place (as found in *Physics* 209^{a}31-213^{a}10) and I attempt to show that, given his position on this topic, he rightly denies the legitimacy of any appeal to the existence of void.

So what is place? Aristotle gives the following inventory of features which we commonly attribute to the nature of place. First, place is three-dimensional – it is able to encompass objects according to their length, height, and depth. Second, place cannot be body since body can exactly coincide with any place (in principle) while it is impossible that two bodies reside in exactly the same place at once. Third, place is not a cause in any of the traditional senses.[43] Fourth, place is capable of alteration; for example, when a tree grows, it maintains its place even as it occupies a greater proportion of room (it does not change place with each miniscule increase in size, rather, its place is said to become larger). Fifth, place is something that can be left behind by an object.

[40]I am not the only one who sees the argument that I am about to present as being the most fundamental challenge to void theory. Helen Lang also treats place as the central feature of the Aristotelian counterattack to void-theory (see both "Aristotle's *Physics* IV, 8: A Vexed Argument in the History of Ideas," 360-362 and *The Order of Nature in Aristotle's Physics: Place and the Elements* (Cambridge: Cambridge: University Press, 1998)). However, Lang treats the argument concerning place essentially as an extension of the causal argument regarding the possibility of motion, (discussed here in §5.II.A-D). I take a distinct argumentative approach.

[41]"Again, the theory that the void exists involves the existence of place; for one would define void as place bereft of body" (*Physics* 208^{b}25-26).

[42]The distinction between 'space' and 'place' for Aristotle seems conceptual. In the works on natural philosophy, he often uses 'space' when he is considering either some sort of traversal or else a geometrical consideration; thus, 'space' is generally used extensionally. On the contrary, he often uses 'place' when considering static localization; thus 'place' is generally used relationally. Of course, his usage does not in any way necessitate a hard distinction between them on a more fundamental level. Thus, for the purposes of this work, it is enough to take space and place as coextensive for Aristotle. They are not, of course, coextensive with whatever fills them, e.g. particular instances of the elements / substances. The latter are metaphysically real while the former are not. Thus, I take what I say here about the nature of place to be manifestly true of space as well. Harold Johnson considers the conceptual divergence between 'space' and 'place.' He makes the case that space is basically the collective of places: "for Aristotle space is nothing more than the sum total of places, no separately existing principle, either material or immaterial, but just the relations of containing and being contained of substances in their activities" ("Three Ancient Meanings of Matter: Democritus, Plato, and Aristotle," in *Journal of the History of Ideas* 28.1 (1967), 6. This seems to me to be in agreement with my take and would explain why space is used when a traversal is in play; for a traversal must involve multiple places by definition since there are at least two of them, a starting point and a terminus.

[43]"None of the four modes of causation can be ascribed to it. It is neither cause in the sense of the matter of existents (for nothing is composed of it), nor as the form and definition of things, nor as end, nor does it move existents" (*Physics*, 209^{a}20-23).

If this were not the case, the notion of a change of place would be a conceptual impossibility, and this is wrong. As such, place is like a vessel for objects. Sixth, for an object to have a place is for it to *be somewhere* and for there to be something *outside of* it. So, if you asked me to identify the place of my office, I'd say "at the end of the hall." But if, instead, you asked me to identify the place of my office without reference to anything external, I would be stumped by the question.

From this list of basic intuitions concerning place, Aristotle infers the following list of essential features concerning the relationship of place to other things ($210^{b}34$-$211^{a}5$):

(1) Place contains things without ever being a part of them.
(2) The primary place of a thing is always identical to its magnitude.
(3) Place must always be separable from the things it contains (it can be evacuated).
(4) One place can always be spoken of in relation to another place.

He then goes on to assert that place must be identifiable with one of the following four things:

(A) The shape (or form) of an object
(B) The matter of an object
(C) The extension of an object
(D) The extremities of an object

Now, matter and form only seem to be possible candidates identifiable with place because they are always found in a place. But we can infer from (3) that place cannot be either the matter or form of a material substance since place is separable from the substance while these principles are not (substances just are the hylomorphic union of form and matter).[44] Moreover, extension may be considered a candidate because it is generally the case that, whenever something moves, its former position is filled by something that is not seen (e.g., air[45]). Nonetheless, extension cannot truly satisfy the requirements identified above because a displaced object ought to be identified with its extension, since it always maintains its extension through mere local change; and this is incompatible with requirement (1). In addition, the notion of a material substance

[44]For example, see *Metaphysics* $1037^{a}29$-30: "the substance is the indwelling form, from which along with the matter the so-called concrete substance is derived."
[45]"For what is called the empty space is full of air" (*Parts of Animals*, $656^{b}16$-17).

being able to leave its extension behind seems absurd, and so there is a conflict between (C) and (3) as well. Thus, by reduction Aristotle concludes that place must be the "innermost motionless boundary" of a containing body at which points it is in contact with a contained body. This, he adds, is to be identified with the extremities of the contained body.

So why is Aristotle's account of place incompatible with treating it as substantial? One possible explanation is that a boundary's essence has an accidental manner of existence since its ground for individuality is dependent upon on a set of extrinsic relations. For example, the exact character of the place of the water in a pool is dependent upon the character of the pool itself; a softer material will result in a more extended boundary while a harder containing material will hold the water back more consistently without giving in to the pressure. But substance, according to Aristotle, can never be dependent for its being upon accidental features of its environment. It is, self-dependent with regard to its essence – it contains its own intrinsic reason for its exact character. Further, those who treat place as substantial are doing so (usually) by treating place as a sort of general extendedness, but this has been shown to be unsatisfactory on the grounds that general extendedness is incompatible with certain other features of place; i.e., (1) and (3) above.

Therefore, if we take Aristotle's account seriously, agreeing that place must exemplify features (1) – (4) and that it can only be identified with one of the options (A) – (D), then we also ought to agree that he appropriately denies the substantiality of place. Hence, in turn, he ought to reject any description of void which takes it to be an existent "place with nothing in it" as well.

5.III THE ARISTOTELIAN AETHER

An account of Aristotle's rejection of void-theory would not be complete without at least some treatment of the aether since aether is the physical material that Aristotle appeals to in

order to explain what constitutes the plenum in the outer spheres. Therefore, in this final section, I briefly describe this infamous doctrine.

To begin, Aristotle was not the first to conceive of outer space as a plenum consisting of material substance. Before him, Anaxagoras proposed the existence of a special kind of fire and labeled it *aether* since "it 'runs always' for an eternity of time."[46] Nonetheless, even though it was considered to be a special variety of fire, it was still fire. But Aristotle thought the substance of the heavenly realms had certain essentially distinguishing features that call for a more strict demarcation: "we may infer with confidence that there is something beyond the bodies that are about us on this earth, *different and separate from them*" (emphasis mine).[47] [48] Thus, Aristotle's doctrine of aether was essentially a new view.[49] Unfortunately, the doctrine is not seriously developed. He only tells us (a) where the element resides, (b) what bodies are constituted by the element, and (c) how to distinguish the element from the other elements. In what follows, I explain these aspects. I also aim to minimize what turns out to be a significant ambiguity that is generated by his account concerning (b).

According to Aristotle, aether resides in the outer spheres of the universe.[50] This is to say that, whereas all instances of the other elements reside between the lunar sphere and the center of

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[46]*On the Heavens* $270^{b}23$-24. The term is sometimes spelled 'ether' in Aristotle's work, but I do not see a conceptual difference between the variant spellings.

[47]On the Heavens $269^{b}12$-14.

[48]Aristotle openly critiques Anaxagoras' rendering in a number of places. See *Meteorology* $339^{b}20$-28, $365^{a}20$-30, and $369^{b}12$-24 as well as *On the Heavens* $270^{b}24$-25. According to James Longrigg, one significant point of distinction between fire and aether is that, while similar in that each is fundamentally identified with heat, aether produces heat with only generative power while fire produces heat with only corruptive power ("Elementary Physics in the Lyceum and Stoa," 213; c.f., Aristotle, "On the Generation of Animals" $736^{b}33$-$737^{a}7$). Those who followed Aristotle both in the Lyceum and in the Stoa generally reverted to the heavens-as-fire view (Longrigg, 222).

[49]Nonetheless, Aristotle purposely chose not to adopt a new name for the substance, for he agreed that eternality was an important distinguishing feature of this substance. Thus, "aether" remained an appropriate denomination.

[50]In total, Aristotle believed that there are either fifty-five or fifty-six spheres that constitute the universe (G. E. R. Lloyd, *Aristotle: The Growth and Structure of His Thought* (Cambridge: Cambridge University Press, 1968), 151-152). The center of the universe, the earth, is the place where the heavy elements exist. Earthy substance is primarily at the center, air and water primarily hover on the perimeter, and fire seeks to get through the perimeter and out toward the spheres. The first official sphere is that of the moon.

the universe (the earth), aether is the only element that transcends the central region.[51] Further, aether is supposed to constitute both the heavenly bodies and the apparently empty spaces that exist between them.[52] So both the dark regions of outer space and the bright objects scattered throughout it are thought to be constituted by the same element. Of course, it seems appropriate to wonder why Aristotle would be inclined to hold such a view. For, why would he find it more appropriate to join the vast expanse of space and the heavenly bodies under a single elemental category when it seems sensible to think that these bodies have more in common with terrestrial objects (earth or fire) than with empty space? Part of the answer to this question can be recognized with little difficulty, but part is more problematic. The unproblematic aspect of the solution concerns Aristotle's denial of the possibility that heavenly bodies can be constituted by any of the traditional four elements. The more problematic part concerns the belief that these seemingly diverse phenomena, the expanse and the heavenly bodies, are taken to be composed of the same element rather than of distinct ones. In other words, why does Aristotle stop short of

[51]It is not conceptually impossible to suppose that aether may coexist alongside the other four elements in the central region of the universe, that which is admittedly occupied by the earth and its atmosphere. Friedrich Solmsen claims that this is not a possibility: "The place of this element [aether] is the entire heavenly region, extending from the First Heaven to the moon; below this, in the regions occupied by the four other elements, it is never to be found. However, beyond the lunar sphere, it is clear that only aether resides" ("The Vital Heat, the Inborn Pneuma and the Aether" in *The Journal of Hellenic Studies* 77.1 (1957), 119). However, it seems to me that Solmsen is actually concerned to prevent the functional identification of aether with either vital heat (thermon) or animal spirit (pnuema), and he expresses no immediate concern for issues of local presence. Thus, because aether has no natural inward or outward directionality, it seems reasonable to think that *it could have* its circular motion even under the lunar sphere. One reason for perhaps challenging the possibility that aether could reside terrestrially would be to make the argument that whatever is more subtle must be on the periphery, and so even if aether had been near the center at some point, it would have to have been worked out of the center by now. One virtue of this rendering is that it could be used to explain why fire doesn't escape out into the spheres. This interpretation would bring to light new difficulties concerning the natural directionality of fire though. Hence, as Longrigg has explained "as soon as the aether forms the upper limits of the cosmos, it becomes nonsense to attribute to fire an absolutely upward motion, and the concept of the absolute lightness of fire is therefore jeopardized" ("Elementary Physics in the Lyceum and Stoa," 214).

[52]The planets and stars are informed by a kind of soul on the Aristotelian view. Thus, they are considered "alive." That is, just as a human soul gives a new character to the traditional elements that constitute its body, so the soul of the ethereal body gives the elemental constituency which it informs a unique character. Thus, the planets and stars become distinguished in a number of new ways from the space between them, as well as from each other.

postulating a sixth element?[53] In what follows, I first explain the unproblematic aspect of the solution and then I attempt to provide some justification concerning the problematic aspect.

In order to understand why Aristotle takes the heavenly bodies to be aethereal as opposed to, say, earthy or fiery,[54] one should remember his other commitments, namely those concerning the character of the traditional four elements. Recall that fire is distinguished by its propensity to move in a straight line away from the center of the universe, and earth by its propensity to move in a straight line towards the center of the universe. On the basis of these commitments, it is clear that to give an account for all of the observable data regarding the heavenly bodies, an additional element needs to be postulated. First, the heavenly bodies could not be earthy simply because all earth is found near the center of the universe and these bodies are not. Now, this inference is not obvious: What if they are still on there way? But the justification is easily understandable when one recalls Aristotle's commitment to an eternal, yet finitely extended universe.[55] Given a universe of that sort, any theory that the planets are earthy bodies that have not yet reached the center is disallowed. Given the reality of an eternal past and limited extension, all earthy objects have had the time to traverse the entire distance that they would need to traverse in order to reach the center by now. Additionally, the heavenly bodies could not be fiery objects since they do not follow the natural pattern of motion (away from the center) that marks off fire from the other elements. Rather, the heavenly bodies revolve around the center at stable distances. That is, the heavenly bodies exemplify a unique natural directionality – circular motion.[56]

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[53]Or perhaps more if he comes to find other relevant distinctions between particular extraterrestrial objects.

[54]In keeping with the earlier discussion regarding the elements and terrestrial objects, I continue to take earth and fire to be primary in a significant, though undeveloped sense. Thus I will not take seriously the general possibility that the heavenly bodies can be constituted by water or air.

[55]Aristotle consistently affirms the temporal eternality of the universe, especially in *Physics* VIII.6 ($258^{b}10$-$259^{a}19$). That the universe must be extensionally finite is evidenced when one considers that he rejects both the existence of a void and also the existence of an infinite body (see *On the Heavens* $276^{a}16$-17).

[56]The fact that the bodies exemplify circular motion may seem to prohibit a simple construal of the planets as mixed bodies, constituted by fire and earth. For such a mixture may be able to get the bodies far from the center, but it may

Thus, the composition of the heavenly bodies is distinct from that of terrestrial ones because "the substance of the heaven and stars we call [a]ether … is in continual motion, revolving in a circle, being an element other than the four pure and divine."[57]

Given the commitments held by Aristotle regarding the nature of the traditional elements, it is understandable that he took the heavenly bodies to be constituted by a unique element. But it still remains to be explained why he goes on to identify the substance that fills the space between the observable bodies with the same element. Aristotle is not forthcoming with a solution. Now, it is easy to make the case that the space between the heavenly bodies, which must be a material substance (given the rejection of void), cannot be constituted by one of the terrestrial elements. For one, space cannot be composed of earth for the same reason that the heavenly bodies could not be composed of earth – all earthy material should have already made it to the center of the universe by now. Likewise, space cannot be either air or water since these are heavy elements in the Aristotelian system, and so should have already found their natural place of rest just above the surface of the earth and below the regions filled by the subtler elements, fire and aether. This leaves the possibility that the interplanetary regions consist of fire.

Fire cannot be discounted on the basis of natural directionality alone. For example, suppose that fire is, by far, the most abundant element in the universe. In this scenario, fire piles up at the limits of the universe and fills the entire expanse between those limits and the Earth's airy atmosphere. Thus, while space is considered inert, it could be because it is composed of fire that has completed its natural journey. Of course, we have to suppose as well that fire could exist

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not be able to cause circular motion. However, I wonder at this. If these elements were proportioned to account for the steady distance from the center and the aethereal medium had circular motion, then it could be the case that the heavenly bodies could be construed as bodies constituted by terrestrial materials and, yet, retain circular motion. There are some assumptions that are needed for this account though, such as that aether could cause the motion of a denser material and that Aristotle would allow for natural circumstances in which natural dispositions are rendered as ineffectual. It is not obvious that either of these assumption would be thought admissible by Aristotle.

[57]On the Universe 392[a]5-9.

without its normal observed qualities in this scenario (e.g., the warm hues and the flicker). Now, suppose also that the only breaks in extraterrestrial fire are the places where a non-fiery heavenly body resides, partaking in its own natural motion. This rendering does not seem impossible when only the evidence of pure observation and free conceptualization is allowed. In fact, this possibility nicely accounts for the view of Anaxagoras that aether is just rarified fire.

Nonetheless, it is quite clear that this is not the position of Aristotle. He could counter this possibility by arguing that either fire or aether has to be the subtler of the two substances. If aether is determined to be the subtler substance and the empty spatial regions are identified with the heavier fire, then it would seem that the supremely light (aethereal) heavenly bodies should all exist at the limit of the universe by now, just as all of the earthy objects ought to be at the center. And if this is so, then all of the heavenly bodies reside on the same spherical plane. But then how can we explain that they never seem to collide when they cross paths? If we take fire as the subtler element, a similar problem arises – only the heavenly bodies will be brought down to the lower edge of the fiery region, just between it and the outer edge of Earth's airy region. But they should still be seen to collide when they cross paths. Perhaps one could argue that no collisions are seen to occur on either rendering because the bodies are so subtle that they simply pass through one another, or maybe some even more mystical event takes place. These alternatives seem at least as difficult to accept as the aether thesis itself, if not more so.

Therefore, if the subtlety of the elemental substance has anything to do with its general location in the universe, and it does for Aristotle,[58] and if he wants to keep the possibility that there are multiple aethereal spheres, one for each of the heavenly bodies, and that the bodies they

[58]"Thus then five elements, situated in spheres in five regions, the less being in each case surrounded by the greater – namely, earth surrounded by water, water by air, air by fire, and fire by ether – make up the whole Universe" (*On the Universe* 393[a]1-4).

contain are separated by great distances, and he does,[59] then it is understandable that Aristotle identifies all of outer space as of the same general substance as the heavenly bodies.

5.IV CONCLUSION

It is now clear why Aristotle denies the existence of void, and what constitutes seemingly empty space. In Chapter Seven, I use the data from this and the next chapter to evidence my main contention that Aristotle and Newton are locked in a state of incommensurability with regard to the question of void's existence.

[59]His fifty-five spheres were supposed to be able to account for the varied motions of individual celestial bodies. Tradition takes him as maintaining the crystalline character of these spheres, though there is nothing in his work that directly necessitates the claim. However, a case could be made that crystalline spheres could be used to explain how the sun can produce heat (by friction) without the sun actually being hot (since aether is not hot). This idea is outlined by Lloyd in his *Aristotle: The Growth and Structure of His Thought*, 160-161. For if the sun is in the center of the crystalline sphere, then it could be maintained that there is heat at the perimeter of the aethereal sphere, produced by the friction involved in its contact with the neighboring sphere, and yet not in the sun itself because of its great distance from the locus of the friction. Other problems still arise here though.

CHAPTER SIX:
THE NEWTONIAN COMMITMENT TO THE EXISTENCE OF VOID

In this chapter, I argue that a consistent interpretation of Newtonian natural philosophy entails a commitment to void's existence. I do not aim to critically assess Newtonian doctrine unless doing so is conducive to making the position clearer. Rather, I aim to provide a consistent and well-considered interpretation of the Newtonian doctrine of void-space, not an argument in defense of it. In the next and final chapter, I draw from Chapters Five and Six, identifying and comparing the fundamental points of divergence between the Aristotelian and Newtonian doctrines, and I argue that the Kuhnian incommensurability model that I have explicated is capable of making good sense of the theoretical disagreement.

The traditional reading of Newton is that he affirms the reality of void. I believe that this interpretation is correct. However, the traditional interpretation is not without textual challenges. Hence, I begin (in §I) by identifying the interpretive problem. Once that difficulty is made clear, I proceed (in §II) to give an account of the Newtonian commitments and to clearly set up a dilemma that must be avoided. Finally (in §III), I appropriate the commitments to develop an argument which escapes the dilemma and substantiates the received view that Newton is committed to the existence of void.

Newton's most forceful presentation of a pro-void hypothesis is found in his unpublished essay, "*de gravitatione et aequipondio fluidorum*" [hereafter, "de Grav"].[1] So my presentation is heavily dependent upon the argument in that work. Nonetheless, there are other resources that are relevant to the question of void's existence as well, including both of Newton's major works

[1]Isaac Newton, "de Gravitatione," in *Philosophical Writings*, ed. by Andrew Janiak (Cambridge: Cambridge University Press, 2004), 27.

(*Principia*[2] and *Opticks*[3]), another of his unpublished works ("de Aere et Aether"[4]), and a few of his personal correspondences.[5] I refer to these works whenever they prove insightful.[6]

6.I IS NEWTON REALLY COMMITTED TO A NON-PLENUM VIEW?

Whether Newton was actually a void-theorist is a complicated matter. A close reading of his works that are directly concerned with the nature of interplanetary space (i.e., "de Grav" and *Principia*) reveal a number of statements that imply a belief that there exist vast regions of outer space in which no physical substance resides. For instance, in "de Grav" he proclaims that

> there are empty spaces in nature. For if the aether were a corporeal fluid entirely without vacuous pores, however subtle its parts are made by division, it would be as dense as any other fluid, and it would yield to the motion of passing bodies with no less inertia…. The largest part of aethereal space is empty, scattered between the aethereal particles.[7]

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[2]Isaac Newton, *The Principia: Mathematical Principles of Natural Philosophy*, trans. by I. Bernard Cohen and Anne Whitman (Los Angeles: University of California Press, 1999).

[3]Isaac Newton, Opticks or Treatise of the Reflections, Refractions, Inflections, and Colours of Light (New York: Dover Publications, Inc. 1952.)

[4]Isaac Newton, "de Aere et Aether" in *Unpublished Scientific Papers of Isaac Newton* (Cambridge: Cambridge University Press, 1962), 221-228.

[5]Isaac Newton et al, *The Correspondence of Isaac Newton*, ed. by ed. H. W. Turnbull, J. F. Scott, A. R. Hall, and L. Tilling, 7 vols., Cambridge: Cambridge University Press, 1959–1984. Further references to these works will be identified by the following model: *Correspondences*, Vol. [*x*], [page(s) *y*(- *z*)].

[6]Newton's writings, valuable as they may be, are full of spellings that are quite inconsistent with modern grammatical expectation. This can be very distracting to the reader. Thus, I have chosen to update his spelling to the modern expectation whenever I can. I have done so without acknowledging the otherwise inconsequential changes (in order to sustain the readability of my own text).

[7]Newton, "de Gravitatione," 35. The interpretation of "de Grav" is not completely unambiguous though, for Newton also seems to explicitly deny the existence of the void in that work: "Although space may be empty of body, nevertheless it is not in itself a void … something is there, because spaces are there, although nothing more than that." This incongruence is a matter of semantics. Here Newton understands void to be a region empty of body, but not necessarily empty of a non-bodily physical being. This distinction will be expressed in detail by the end of this chapter. On the contrary, I take void to be a physically empty region. Thus, there is no real incoherence between the "no-void" statement and the affirmation of empty spaces. There is actually a textual argument to be made that shows Newton, sometime after 1716, adopts a more standard understanding of void as the contrary of body. The text of consideration is an unpublished version of what seems to have been a revised introduction for Section III of the *Principia* and is discussed in great detail in J. E. McGuire's "Body and Void and Newton's De Mundi Systemate: Some New Sources," *Archive for History of Exact Sciences* 3 (1966), 217-224. From the manuscripts, McGuire infers that "the terms body and void are interdefined: they are, in fact, treated as correlative terms. What one is, the other is not. Body is tangible, impenetrable, movable, that which acts and offers resistance; whereas, void space has contrary qualities: intangibility, penetrability, immovability, passivity, and hence offers no resistance" (224).

However, in the later editions of the *Optics*, written decades after "de Grav" and the *Principia*, many of Newton's controversial Queries are introduced for the first time. Those of immediate concern are Queries 21 and 22, where Newton seems to express belief in a non-fluid aethereal medium which serves as a mechanism for explaining universal gravitation.[8] If he is committed to such a view, this could be problematic for the historical claim that I am making, that Newton and Aristotle hold incommensurable positions on void.[9]

There are a couple of ways that one could resist the claim that Newton was espousing a position more or less equivalent to Aristotle's. First, one could make the case that the Queries in *Opticks* were meant to be taken only as suppositional and not as reflecting Newton's own view. In a letter to Fontenelle concerning the 1719 edition of the *Opticks*, Newton seems to offer some support for such an interpretation: "Here I cultivate the experimental philosophy as that which is worthy to be called philosophy, and I consider hypothetical philosophy not as knowledge but by means of queries. And the matters I have added to this edition are of the latter type."[10] However, I am not at all convinced that this approach works since Newton never explicitly states that these queries are hypotheses towards which he is actually disinclined. Rather, because the aethereal hypothesis is the only mechanical explanation for gravitational phenomena that is considered in the Queries, I think that it is likely that this is the mechanical account he finds *most* appealing.

A second approach is to contend that Newton's latest views are actually consistent with the received view, that Newton accepts the existence of void. In the conclusion to this section, once I have provided enough theoretical context, I offer my defense of pro-void consistency. I

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[8]Newton, *Opticks*, 350-352.

[9]In fact, were I to undertake the distinct project of contrasting Aristotle's plenum view with the prominent plenum view in Newton's day (i.e., Descartes'), I would differentiate them on the very basis that a Cartesian model takes aether to be a mechanical fluid whereas the Aristotelian aether does not possess fluid-mechanical properties. Thus, this Newtonian allusion to aethereal plenum *seems* to bring his view into what might be considered an Aristotelian camp.

[10]*Correspondences*, Vol. VII, xxxvi.

also offer a textual reason to think that the interpretation which I offer is, in fact, Newton's view; though the textual argument is not entirely conclusive.

6.II. SOME SIGNIFICANT ELEMENTS OF NEWTONIAN DOCTRINE

In this section, I present an argument in favor of the pro-void interpretation of Newton. I begin by describing Newton's conception of aether (§6.II.A). This is necessary because aether is the apparently ubiquitous element that threatens a pro-void interpretation.[11] Next, I characterize Newton's distinction between absolute and relative space, showing that it does not help Newton to evade the present controversy (§6.II.B). After that, I explain Newton's "de Grav" arguments against a Cartesian plenum (§6.II.C). Finally, I explain the most fundamental commitment of my interpretation of Newtonian natural philosophy, his distinction between body and extension (§6.II.D). All of these considerations, taken together, provide the necessary data for establishing my claim that consistent Newtonian doctrine entails a pro-void commitment.

6.II.A The Newtonian Aether

A description of Newton's natural philosophy that lacks an account of his conception of aether would be fundamentally deficient.[12] This is because Newtonian aether is used to avoid a host of challenging mechanical problems that would bother the seventeenth-century experimental

[11]In addition, the Newtonian and Aristotelian aethers turn out to be importantly distinct, and I want to explain how in order to avoid any confusion moving forward.

[12]Henry Guerlac suggests that Newton actually abandoned the aethereal thesis for a while (from the 1680s until after 1706), only to recommit to it later in his life after considering the experimental work of Francis Hauksbee (see "Newton's Optical Aether: His Draft of a Proposed Addition to His *Opticks*," in *Notes and Records of the Royal Society of London* 22.1 (Sep. 1967), 45-57). Thus, one may wonder if labeling a non-aethereal reading of Newton as non-Newtonian is an overstatement. I don't think it is. Although I agree that Newton did not speak much about this topic in this period, I am skeptical of the revival hypothesis. A consideration of Newton's *Correspondences* during this period seem to imply that he was simply interested in distinct issues at the time (e.g., theological, political, and economic matters). Additionally, the scientific activity that seemed most significant for Newton during these times was the observation and calculation of astronomical events, not concerns about terrestrial light and heat propagation, magnetism, or other issues in natural philosophy that are regularly explained in aethereal terms. Thus, I take it that Newton likely held the aether in high regard throughout his career.

scientist. For example, aether plays a significant role in each facet of the Newtonian world-picture – i.e., in his optical, electrical, and gravitational theories. My account is only concerned with its role in Newton's gravitational theory, so I limit my consideration to that topic. First, I explain how aether is said to account for gravitational phenomena. Then I explain why, in virtue of its ability to do so, Newtonian aether should *not* be identified with Aristotelian aether. Finally, I argue that the fundamentality of aether in the Newtonian system has no bearing on the question of whether or not void happens to be systematically allowable on a Newtonian view.

To begin, Newton believes that "the globe of the earth is solid and dense."[13] Thus, his terrestrial realm *is* a plenum. Generally, Newton follows the Cartesian view that there are three sorts of elemental particle to be found in this dense, terrestrial realm – coarse earthy particles, fine airy particles, and the most subtle aethereal particles. These three types of particle, however, should not be taken as unique in their materiality. Instead, Newton holds that there is actually a continuum of coarseness that is instantiated in one basic kind of matter. Thus, the Newtonian account admits of a potentially infinite number of distinct gradients of coarseness out of which a few instrumental conceptual distinctions may be made. This explains how, on Newton's account, it is thought possible to transmute earthy particles into the aethereal ones:

> Just as bodies of this Earth by breaking into small particles are converted to air, so these particles can be broken into lesser ones by some violent action and converted into more subtle air which, if it is subtle enough to penetrate the pores of glass, crystal, and other terrestrial bodies, we may call the spirit of air, or the aether.[14]

One might wonder why Newton does not simply distinguish visible material particles (i.e., solid matter) from non-visible material particles (i.e., airy matter). He would answer that postulating a more subtle instantiation of matter is scientifically necessary since it is required by multiple

[13] This quote is actually from a letter *to* Newton *from* Richard Bentley that was written on 2-11-1692/3 (*Correspondences*, Vol. III, 247). However, Newton affirms his commitment to the statement in a letter written just two weeks later (ibid., 253).
[14] "de Aere et Aether," 227.

experiments.[15] First, Robert Boyle discovered that a hermetically sealed and vacuum pumped glass container in which a piece of metal is kept becomes heavier when the metal calcifies. Boyle inferred from this that a distinct substance, something more subtle than air, intrudes into the experimental field and brings about the effect. Second, Newton took the existence of aether to be a demonstrable fact because a pendulum slows down in a vacuum-pumped chamber. The only explanation for such resistance, he thought, is that a subtle fluid medium is involved in the event. A contemporary theorist, of course, might think that Newton's later gravitational theory provides him with the conceptual resource needed to avoid this inference. But this would be mistaken since, as we shall see, Newton eventually treats gravity itself, at least terrestrial gravity and perhaps even universal gravity, as a function of aether.

In summary, Newton's general doctrine of aether amounts to an identification of the fundamental particles of material reality as aethereal and the more complex units of matter that are constituted by the fundamental particles as either airy or earthy. This seems to be exactly what Newton has in mind when he suggests that

> perhaps the whole frame of nature may be nothing but various contextures of some certain aethereal spirits or vapors condensed as it were by precipitation, much after the manner that vapors are condensed into water or exhalations into grosser substances though not so easily condensable; and after condensation wrought into various forms, at first by the immediate hand of the Creator. Thus, perhaps, may all things be originated from aether.[16]

On this rendering, then, aether is not a mystical substance, but just the most simple and malleable form that matter can take.

Nonetheless, in an aethereal state, Newton thought that matter has some unique empirical qualities that are not recognized in larger chunks. For example, Newton uses aether to explain the immediate cohesion of rigid objects. The general character of this function is explained in a

[15]ibid., 227-228.
[16]Newton to Oldenburg (12-7-1675) in *Correspondences*, Vol. I, 364.

letter from Newton to Boyle.[17] In the letter, Newton describes aether as diffused through all terrestrial places. However, this is not, properly speaking, the natural state of aether. For all aether has a natural disposition to reach the innermost pores, called the interstices, of objects in the terrestrial realm. Newton calls this disposition "endeavor" or the *vis inertiae* of aether. Others may think of this as a natural tendency.[18] Because the space in the interstitial regions is limited, the *vis inertiae* of aether leads to a peculiar state. On the outer surface of solid composite bodies, the bodies in which the interstices are present, the aether congregates, as if each particle awaits an opportunity to get inside. The sheer volume of aethereal particles at these locations causes a compression effect on such objects. The result is a pressure-induced material cohesion.[19]

It is not difficult to move from a cohesion-explanation of particular bodies to a cohesion-explanation of astronomical bodies. Thus, it should not be surprising that Newton takes aether to be a candidate mechanism for explaining universal gravitation. That is, perhaps the endeavoring aether of one astronomical body could get involved in some mechanical relationship with either another astronomical body or the endeavoring aether of another astronomical body in such a way as to bind them together, even though their solid surfaces are separated by great distances.[20] Of course, for Newtonian theory to accommodate this mechanical explanation of gravitation on the

[17]The letter, written on 2-28-1679, is found in *Correspondences*, Vol. II, 288-296. Newton discusses the same phenomena in the 12-7-1675 letter to Oldenburg (*Correspondences*, Vol. I, 367) as well.

[18]This disposition should bring to mind Aristotle's doctrine of natural places which was discussed in the previous chapter. However, for Aristotle, it was the nature of aethereal substance to rest in the outer regions of the universe whereas, for Newton, the nature of aethereal substance is to find its resting place in the tightest terrestrial regions.

[19]In fact, it can be inferred that Newton, even near the end of his life, saw no other way to mechanistically explain cohesion: "How such very hard particles which are only laid together and touch only in a few points, can stick together, and that so firmly as they do, without the assistance of something which causes them to be attracted or pressed towards one another, is very difficult to conceive." (*Opticks*, Qu. 31, 390).

[20]The nature of this commixing act is ambiguous. One author identifies it as "a component of a 'sticky' nature," where the stickiness is the result of absorption (L. Rosenfeld, "Newton's Views on Aether and Gravitation," in *Archive for History of Exact Sciences* 6.1 (1969), 31ff. I suspect that the commixing is open to a more simplistic "intertwining" interpretation as well. Other authors emphasize the repellant effects of aether for sustaining the state of the universe. This interpretation is more conducive to the argument that I am making, that Newton is committed to the existence of void (and, as a consequence, the action-at-a-distance interpretation of gravitational attraction). See, most notably, John Henry's "Gravity and *De Gravitatione*: The Development of Newton's Ideas on Action at a Distance," in *Studies in History and Philosophy of Science* 42, 2011, 11–27.

universal level, it must then be admitted that the stock of aether in the universe is abundant. Newton was not blind to this as he considers that aether might be "expanded through all the Heavens."[21] In §6.II.C, I consider how using aether to explain universal gravitation in this way might be modeled and I identify the most troublesome consequences for such a model. For now, let us close our initial discussion of Newtonian aether by expressing the reasons for taking it to be distinct from the aether postulated by Aristotle.

Recall that, in the Aristotelian system, aether is the substance that fills the heavens and constitutes the heavenly bodies. Also recall that there is no aether within the earthy region of the Aristotelian universe. Thus, aether could not have been appealed to by Aristotle to explain any of the phenomena that Newton invokes it to explain. What's more, Aristotelian aether is postulated partly for the sake of place-holding an undetected, yet necessarily existent, material substance that resides in the seemingly empty regions of outer space. That is, on Aristotle's view, the full presence of aether was a conceptual necessity irrespective of its mechanical efficacy. On the contrary, it is not the case that Newton's aether has such a role. The only reason to invoke aether on the Newtonian view is that there is some cause-effect relationship in need of a mechanical story that a very subtle matter is best able to explain.[22] Finally even if universal gravitation needs a mechanical explanation on Newton's view, the presence of void is not ruled out *a priori*. This will be expanded upon below. Therefore, not only are the Aristotelian and Newtonian aethers distinct, but they differ in a way that is relevant to the question of whether void exists.

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[21]Newton, *Opticks*, 349.

[22]This is actually a point of controversy in the current literature. A number of very influential expositors, in specifically Newtonian works, including Alexandre Koyré, (*Newtonian Studies*, London: Chapman & Hall, 1965, 149-163), I. Bernard Cohen, (*The Newtonian Revolution*, Cambridge: Cambridge University Press, 1980, 72-78), and Andrew Janiak (*Newton as Philosopher*, Cambridge: Cambridge University Press, 2008, 77-79) maintain that Newton not only doubted but had a strong aversion to scientific explanations that rely upon any notion of action at a distance. John Henry, on the contrary, argues that they are seriously mistaken ("Gravity and *De Gravitatione*: The Development of Newton's Ideas on Action at a Distance").

6.II.B Absolute vs. Relative Space

Before presenting either Newton's argument against the existence of a spatial plenum or an argument in favor of his commitment to void, it is worthwhile to consider what many take to be the most important distinction concerning Newton's conception of space – the distinction between *absolute* and *relative* space. While I acknowledge that this distinction is central to Newtonianism on the whole, I explain why it is not of central importance to my project.

As stated in the *Principia*, absolute space is space construed according to "its own nature without reference to anything external."[23] It "always remains homogeneous and immovable."[24] Absolute space is put into contrast with relative space, which is

> any moveable measure or dimension of this absolute space; such a measure or dimension is determined by our senses from the situation of the space with respect to bodies and is popularly used for immovable space, as in the case of space under the earth or in the air or in the heavens, where the dimension is determined from the situation of the space with respect to the earth.[25]

In order to make this distinction clearer, Newton provides the following example:

> [I]f the earth moves, the space of our air, which in a relative sense and in respect to the earth always remains the same, will now be one part of the absolute space into which the air passes, now another part of it, and thus will be changing continually in an absolute sense.[26]

In the example, "space of our air" is a reference to the earth's atmosphere as a whole. Thus, as the earth flies through the universal expanse, it does not come into new spatial relations with respect to its atmosphere. In this relative sense, then, the earth can be treated as occupying a single space – the space in the midst of its atmosphere. However, it is clear that there is a second spatial sense, the sense in which the whole atmosphere and the earth are in motion. In this absolute sense, the moving entities, the earth and its atmosphere, are said to change their place.

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[23]Newton, *Principia*, 408.
[24]ibid.
[25]ibid., 408-9.
[26]ibid., 409.

It is clear that one cannot be both in the same place and not in the same place at the same time and in the same sense. Thus, there must be an essential difference between absolute and relative space that allows for the distinction. The difference is ontological in character. Hugh Lacey explains the ontological difference when he identifies a commitment to absolute space as a commitment to the existence of both "pure spatial entities – points, positions or places" and "bodies or physical objects which occupy points or places," whereas one committed to a relational doctrine of space admits only the existence of spatially related bodies.[27] Initially, it is not clear that this ontological distinction implies the existence of void. That is, it is feasible that a material plenum is consistent with the concept of absolute space. For example, perhaps a plenum is constitutive of absolute space.[28] In such a scenario, the moving earth could be said to change

[27]Hugh Lacey, "The Scientific Intelligibility of Absolute Space: A Study of Newtonian Argument," in *The British Journal for the Philosophy of Science* 21.4 (1970), 319. That the doctrine is fundamentally ontological is supported further by pointing out that Newton's most famous arguments for the existence of absolute space, both the bucket and two-bodies experiment, rest on the generation of new causal relations that cannot be accounted for on the relational theory. Lacey's paper is a development of these arguments. The arguments (even in their developed state) however, are not conclusive (and, in fact, are unsound); he does think, though, that they are decisive against those early-modern renditions of the relational view. For an alternative approach to Newton's bucket experiment, where it is treated not as an argument in support of the existence of absolute space and against the existence of relative space, but rather as either (a) a mere illustration of what the difference between absolute and relative motion *look like* in a Newtonian system, or (b) a refutation of a specific relational system, that of Rene Descartes, see Ronald Laymon, "Newton's Bucket Experiment," in *Journal of the History of Philosophy* 16.4 (1978), 399-413. Robert Rynasiewicz has a nice pair of essays echoing Laymon's view, but adding an emphasis on the distinction between the bucket and two-bodies experiments ("By Their Properties, Causes and Effects- Newton's Scholium on Time, Space, Place and Motion—I. The Text" and "By Their Properties, Causes and Effects- Newton's Scholium on Time, Space, Place and Motion—II. The Context" in *Studies in History and Philosophy of Science* 26.1 (1995), 133-153 and 26.2 (1995), 295-321. Ori Belkind adds a response to Laymon and Rynasiewicz in "Newton's Conceptual Argument for Absolute Space," in *International Studies in the Philosophy of Science* 21.3 (2007), 271-293. He contends that Newtonian motion must be understood quantitatively as a measure of Newtonian "place." But the possibility for an absolute measure of motion entails the presence of an unmoving container-place, i.e., absolute space. Thus, he contends, it is only by supposing absolute space that one can distinguish absolute from relative motion. Hence, one cannot simply identify the bucket experiment as inconsequential with regard to Newton's concern for absolute space.

[28]Actually, Stephen Toulmin contends that "no natural reference-frame, however perfect, could properly be identified with Newton's "absolute space.'" Rather, absolute space is taken to be a dynamical, or mathematical ideal that is not subject to material or metaphysical instantiation. As a result, the question of whether absolute space exists turns out to be a red herring. I tend to agree with his assessment insofar as the *Principia* definitions are concerned, but this does not undermine the fundamental claim that I am making, namely that the character of absolute space is initially not obvious. In fact, the whole point of Toulmin writing this article is to challenge those who take Newton as identifying absolute space with a physical substrate of some sort. Thus, it stands to reason, the fact that there is a felt need to write his article in the first place implicitly supports my view that the discussion in the definition section of the *Principia*, at least on the surface, is open to more than one understanding. See "Criticism in the History of Science: Newton on Absolute Space, Time, and Motion, I" in *The Philosophical Review* 68.1 (Jan. 1959), 21-25.

its place in virtue of the fact that it pushes through (or around?) a steady aethereal substrate. Of course, the scenario may necessitate further suppositions, for example that aether either can be penetrated by the air or can absorb the shock of contact with air particles without itself being put into motion. In fact, it is likely that the view would require many such suppositions. Thankfully, my aim does not require that I develop the account. It is enough to show that admitting the distinction between absolute and relative space does not *compel* belief in the reality of void. Hence, this feature Newtonianism is of little help in establishing a solution to the question of void's existence. However, I will show that Newton's position, more subtly considered, does demand that there be void places in the midst of absolute space. To see this, let's first consider the anti-Cartesian argument from "de Grav," the treatise that J. E. McGuire calls "Newton's most philosophical account of his doctrines of absolute motion, place, space, and time."[29]

6.II.C The Newtonian Critique of Cartesianism

Rene Descartes held a plenum view of space. In his rendition, the material that constitutes the interplanetary regions of space is aether. Now, aether in the Cartesian view is not just a static material substance setting a physical backdrop to the universe. Rather, Cartesian aether is active, coalescing into large swirling regions called vortices. Vortices are supposed to be the mechanical causes of all astronomical motion. However, even if it were the case that Cartesian aether had no mechanical function, Descartes thinks that the existence of void must be rejected. For the necessary identification of extension and body demands it. Thus, in order to show that Newton's view stands in contrast to a plenum-interpretation, it is not enough that I simply demonstrate that Newton undermines Descartes' vortex-theory mechanics. If that were all that was needed, I

[29]J. E. McGuire, "Newton on Place, Time, and God: An Unpublished Source," in *The British Journal for the History of Science* (1978), 124.

would just appeal to the *Principia* critique.[30] Rather, to break away from a plenum-friendly interpretation of Newtonianism, I need to show that Newton is distinguished from Descartes on a deeper level. This is the enterprise for which "de Grav" proves to be uniquely valuable.[31]

The "de Grav" critique focuses mainly on the unpalatable conceptual ramifications of a Cartesian plenum-view. As Newton explains, when the "absurd consequences" of the view are recognized, this should "convince us how confused and incongruous with reason this doctrine is."[32] Newton offers almost a dozen blatant incongruities that plague the Cartesian account. I consider a number of these criticisms here. Let me emphasize that these are not of immediate significance to my thesis, that Newton accepts the reality of void. But they are instrumentally important in the sense that they establish good reason to disassociate body and extension, and this move *is* fundamentally important to my thesis.

The first blatant incongruity in the Cartesian account concerns his distinction between philosophical and non-philosophical motion. Newton's contention is that Descartes at once seems *to deny* planetary motion in his "philosophical sense[33] (which Newton takes as the proper, or real sense of motion), while continuing *to affirm* that planets recede from the sun in gyrating aethereal vortices.[34] Hence, it seems that Descartes would be committed to something like the following statement: "The planets are not really in motion, but they really change their position

[30]That Newton has done enough to undermine the Cartesian vortex theory is uncontroversial. The systematic dismantling of the view is found in *Principia*, especially in the Book II Section 7 Scholium (750-761) and in Book II Section 9 (779-790). There is also a solid recap in the General Scholium (939ff).

[31]Newton's "de Grav" was not written solely with this destructive purpose in mind, though this destructive task does subsume the greater portion of the work. According to Newton, the work was written to treat "the science of weight and of the equilibrium of fluids and solids in fluids" (*de Gravitatione*, 12). As I understand the issue, the reason that he attacks Cartesianism here is that (a) he wanted to ground the characterization of these distinct material states in geometry, and (b) he believed that Cartesianism was a threat to geometrical reasoning.

[32]ibid., 15.

[33]See §III.26-29 of Descartes, *Principles of Philosophy*, trans. by V. R. Miller and R.P. Miller (Dordrecht, Holland: Reidel, 1983), 94-96. Further references to this work are formatted as follows: Descartes, *Prin.*, [section], [page(s)].

[34]Descartes, *Prin.*, §III.140, 168-69. The identification of the philosophical sense of motion as the "real" or "proper" sense of motion is most likely the point at which the Cartesian would push back. As I read Descartes, there seems to be no obvious basis for this suggestion.

with respect to the static sun." To give a clearer presentation of the worry, I discriminate the philosophical and non-philosophical senses of motion in more detail.

The "philosophical sense" of motion can be characterized as the transition of a body, *X*, from the immediate vicinity of one distinct *fixed* body, *A*, to the immediate vicinity of another distinct *fixed* body, *B*.[35] In such a circumstance, *X* is said to have philosophical motion while *A* and *B*, since they have been characterized as *fixed*, do not. Philosophical motion is contrasted with non-philosophical motion. An object, *Y*, is engaged in non-philosophical motion whenever it happens to be a participant in the motion of the collection of bodies that immediately surround it (S_1, S_2, S_3 … S_n), but it is not itself actually moved in the philosophical sense. Of course, this needs further explication.

Let {S} be used to designate the set of objects denoted by S_1, S_2, S_3 … S_n. Let it also be stipulated that an object is in {S} iff that object is directly in contact with *Y*. "Direct-contact" is just the relation that I have in mind by "immediately surrounds an object." Now, let us consider the relationship of {S} to *Y* at the distinct, though consecutive times, t_1 and t_2. Let it be stipulated that {S} is identical at t_1 and t_2, meaning that all and only the objects in {S} at t_1 are in the direct-contact relationship with *Y* at t_2. Now, let us consider that, for at least some object in {S}, either (a) that object comes into a new direct-contact relationship at t_2 (on an opposing side from which it remains in contact with *Y*), or (b) it is itself surrounded by an object or set of objects {S'}, and {S'} remains unchanged from t_1 to t_2, and at least one of the objects in {S'} comes into some new direct-contact relationship, or (c) within a finite number of layers of surrounding object-sets, it is the case that one comes to identify a direct-contact relational change. If either (a), (b), or (c),

[35]By "fixed" I understand that *A* and *B* are not involved in any new spatial relationships that are not entirely the result of the philosophical motion of some other object. The "immediate" qualification here will be important too, as will be seen. The best way to conceive of this qualification is to take it as identifying an extensional point of contact.

it is said that *Y* is non-philosophically moved and, yet, remains philosophically static. See Figure 6.1 below for a pictorial representation of an instance of case (a).

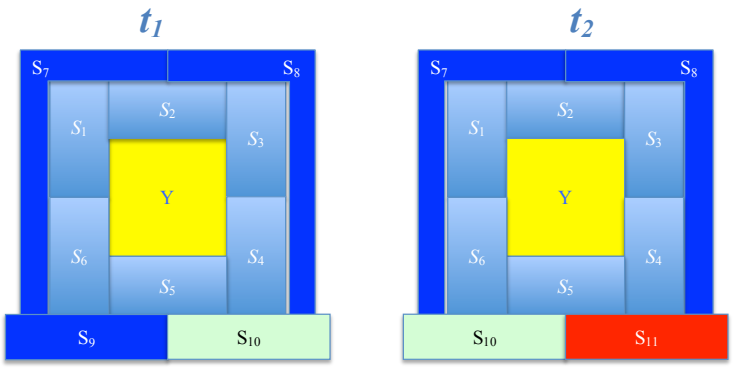

Figure 6.1 In this scenario of non-philosophical motion type (a), it can be said that Y moves with respect to S_9, S_{10}, and S_{11}, even though it never changes its direct contact relationships.

The scenario described above and represented in Figure 6.1 is ambiguous with respect to attributions of proper motion. That is, it is not clear whether the contact-relationship changed because the set constituted by *Y* and $S_{1\text{-}8}$ slid to the right, whether the surface represented by $S_{9\text{-}11}$ slid to the left, or whether both of these events happened. Thus, while it is intuitively obvious that some instance of local motion has taken place, it is not clear which objects move in the fundamental sense of the term – i.e., geometrical displacement with respect to general position in the universe. In fact, for at least some objects in the account, those that achieve no new relations (S_1, S_2, S_3, and *Y*, respectively), it is possible that there is no motion in either a proper or philosophical sense and that they are only said to have moved in an improper sense. Thus, non-philosophical motion is not appropriately identified as the fundamental sense of motion.

Now, returning to the criticism, on the Cartesian model the planets are proclaimed as *not moving* in the philosophical sense, but only in a non-philosophical sense – according to sense (c) above. That is, Descartes takes a planet to be carried around the sun in a swirling vortex of aether, yet without its surface undergoing direct-contact (philosophical) motion with respect to

the totality of aether particles that surrounds it. Thus, it is not able to be characterized as moving in a "real," "proper," or fundamental sense. But this is an absurd view since the location of the planet with respect to the presumably static sun is admittedly changing.[36] And what more fundamental conception of motion can there be than for an object to undertake a clear change of place with respect to a static body? So, Newton concludes, the Cartesian conception of motion is, at the very least, seriously flawed, if not incoherent.

Newton's second charge of blatant incongruity concerns Descartes' distinction between proper and imagined motion. As I understand it, this distinction should not be taken as picking out the same divergence that was identified by making the philosophical vs. non-philosophical motion distinction. Rather, this distinction is unique. On my reading of Descartes, the distinction between philosophical and non-philosophical motion should be taken as a sub-distinction found within the imagined side of the new distinction discussed here. As such, this new division is the more fundamental of the two. Therefore, Newton is working into deeper regions of the Cartesian system with this criticism.[37]

Now, Newton claims that Descartes maintains a belief that each body has its own true and proper motion (or state of rest). But, Newton continues, Descartes is likewise committed to the belief that many (if not all) motions that are *considered* to be proper motions are portrayable as figments of the imagination.[38] That is, it is possible to characterize a real instance of motion as a merely imagined motion. Hence, given such a commitment, it may be inferred that Descartes' must either allow that some motions are both proper and imagined (real and unreal) at the same

[36]This is evident because the distance and angular relations are in flux.
[37]Newton does not treat the philosophical vs. non-philosophical distinction as one within imagined-motion. If he did, then he could not have faulted Descartes for the inability of that distinction to capture the "real" or "proper" motions of things. Nonetheless, since this is the more fundamental distinction, the failure of the first criticism is not necessarily problematic for the total Newtonian critique. It remains to be seen whether Cartesianism fails here.
[38]Descartes, *Princ*., II.29-30, 53-54.

time, or he must admit that the proper motions are not naturally identifiable. Though each option might be undesirable, it is clear that one of the two should be preferred. The first option involves an obvious contradiction, and should be abandoned without consideration. Although the second option does not involve a contradiction, Newton thinks that it has disastrous consequences for philosophical physics. For it demands that any justification for distinguishing between real and imagined motion is inaccessible. Without being able to distinguish between real and imagined motion, however, any claim that nature's actual motive character has been found is misguided.

Let's consider how the Cartesian hypothesis is thought to entail this. To begin, Descartes allows that an object may be described as being both at rest and in motion at the same moment of time (albeit in distinct senses). Take Descartes' favored example of a shipman who, while at rest with respect to the decking of the ship, is taken to be in motion with respect to the shore. For the sake of making the matter more troublesome, let us also put him in a state of rest with respect to the sun by having the impressively built ship moving eastward at the exact speed that the earth rotates towards the west. In addition, I ask that we ignore for now the orbital rotation of the earth around the sun, assuming that it does not occur. Newton complains that, in circumstances such as these, without designating one or more of the motions involved as proper, Descartes could never objectively pinpoint an instance of proper motion or rest. As a result, short of mere stipulation, he lacks a determinate ground for distinguishing instances of proper motion from instances of imagined motion. But, without empirical justification, how can an empiricist claim to be identifying proper motion at all?[39] Since Descartes lacks the conceptual resources to perceptually identify any instance of proper motion, he must, then, admit that, for all he knows, any of the motions he wants to identify as real *may be* merely imagined. This honest concession would get

[39]Of course, Descartes is no empiricist, but Newton is. Thus, perhaps he can be taken as appealing not so much to a Cartesian, but to the physicist who's enamored by Cartesian philosophy but wants to remain an empiricist.

Descartes out of the dilemma, to be sure. But it would undermine his ability to obtain empirical knowledge concerning, for example, planetary motion. Thus, on the Cartesian account, perhaps it's not really the case that the earth is being carried around by a moving vortex, but rather it is static and everything else is in motion. In other words, it seems that Cartesian doctrine allows that geocentricism be true. For Newton, such an admission would be tantamount to giving up on realistic physics and astronomy altogether.[40] No physicist ought to be pleased with this.[41]

Newton's third charge of blatant incongruity concerns problems that arise for instances of both proper philosophical motion and imagined philosophical motion. The challenge follows from the admission that there is difficulty involved in knowingly identifying instances of proper motion – that a Cartesian view makes it difficult to identify true motive facts. I explain Newton's worry by developing a pair of example problems, neither of which is directly raised by Newton in "de Grav," though both are consistent with the worry.

First, Descartes' view is problematic because he posits a single motion that corresponds to the natural state of affairs while, at the same time, allowing that there are innumerable motions taking place within that state of affairs.[42] Consider again the shipman scenario that is introduced in the preceding pages. Let us grant once more, for argument's sake, that the sun is at rest, that the ship is fast enough to move eastward at a rate sufficient to keep up with the earth's rotation,

[40]Certainly, Descartes would deny the truth of classical geocentrism. But it is not obviously the case that the mere possibility that a consistent construal of the universe as geocentric would bother him.

[41]As was the case with respect to the previous proposed incongruity, I find Newton's concern to be lacking here. In fact, it seems to me that this charge is based upon a misreading of the cited text. The only clear reference to *nature* in the section of *Principles* referred to by Newton is the *nature of motion itself*, not the natural motion of particular things. In fact, because Descartes denies the likelihood of being able to find a fixed point in the universe (*Princ.*, II.13, 45), it can be inferred that he would probably hold that any proclamation about true motion must involve the prior postulation of a fixed point by which one could describe the movement, a postulation which could be wrong. Thus, it is true that an attribution of fixed motion is dependent upon the imagination for the Cartesian and, hence, not completely objective. But whether this in incongruous is not obvious. In fact, this might even explain why he felt impelled to make the distinction within imaginative motion – he wanted to be able to have some level of objective distinction in play! That said, Newton is not without contemporary support with respect to these anti-Cartesian arguments. For example, see Ori Belkind, "Newton's Conceptual Argument for Absolute Space," 283-286.

[42]Descartes, *Princ.*, II.31, 54.

and that the orbital rotation of the earth around the sun does not occur. The result is that the shipman is in a state of rest with respect to nature. Of course, he is not experientially privy to his staticity. But there is something that *is* experientially obvious to him. While traversing the ocean with great speed, the shipman feels the wind slamming against his face. Thus, he is surely in a state of philosophical motion. But, one may wonder, without being able to identify the true state of nature with respect to the static sun, what would the Cartesian shipman envision to be a more likely interpretation of his place in nature, that he is in motion or that he is at rest? I suggest that he would find the claim that he is at rest too strange to be correct, given his present state of philosophical motion. Of course, while it is not rationally absurd for him to doubt that he is at rest, it would indeed be a strange conclusion, especially for Descartes given that his universe is providentially cared for according to the will of a non-deceiving God.

In fact, the problem touched on here by Newton can be compounded even more. Let us now imagine that the shipman is a human machine like that identified in Descartes' *Treatise on Man*. Thus, the shipman has a pumping heart, a pair of pulsating lungs, and a stream of animal spirits coursing through his nervous system, sustaining his vital processes. Are the inner motions identifiable as proper? They are certainly instances of philosophical motion since the surfaces of all the organs as well as the inner walls of the nerves are in a constant state of flux with respect to the animal spirits (their direct-contact relationships never remain the same from moment-to-moment). But it seems that this cannot be the end of the story. For if the internal processes are instances of philosophical motion within a resting body, it follows that the internal organs are in a state of proper motion. But this result raises a wonder: how is it that the whole body is not in motion in virtue of its position with respect to the sun even though the vast majority of its parts are? Of course, I am not suggesting that there is no interpretation of the Cartesian system that can

be made to make sense of this scenario. But it sure does bring up some difficult problems that should be addressed. But the empirical physicist should not occupy his time with such abstract concerns. Thus, she may be better off just abandoning Cartesianism altogether.

In addition to these incongruities, Newton also finds a few very serious, albeit attenuated theoretical problems with the Cartesian view. First, on Descartes' view, motion can be generated where there is no new motive force. For example, imagine that God were to bring the flow of the earth's vortex to screeching halt, but without halting the earth's linear momentum. Philosophical motion will then be attributable where it was not before (i.e., at the earth's surface), even though there was no actual change in the inertial description[43] of the earth itself. To attribute new, proper motion to earth on the mere basis of extrinsic happenings seems questionable at best.

Additionally, the reverse will be true, as it is possible that even the greatest of all forces could, in some circumstances, fail to produce motion. Thus, Newton surmises, God could stop the entire universe of its current motion, only to spin it in the opposite direction in such a way that its parts uniformly accept the impetus. Such a monumental event would not be able to be described as a motion in any sense on a Cartesian view since there would be no corresponding change of relational properties. But this implication also seems patently absurd.

Finally, we have already noticed that the Cartesian view makes it impossible to discover which bodies are *really* in motion and which are *really* at rest. In fact, it turns out that it is also impossible to give a geometrical description of any particular motion. This follows because the possibility for giving a geometrical description of a motion requires that the point of the motion's origination be identified and stated as an axiom. But we cannot identify the point of origination in real cases of motion. For such points are no longer in existence because the relational features that are essential to their identification are no longer found in any existent location. That is, if an

[43]The descriptions here are those of the prior state of the earth and the posterior state of the earth.

object is said to be constantly moving, and given that the object's location is defined in a strictly relative way, then as soon as the object's moves out of its current location, entirely new relations are formed. To see what I have in mind more clearly, let's use Figure 6.1 again.

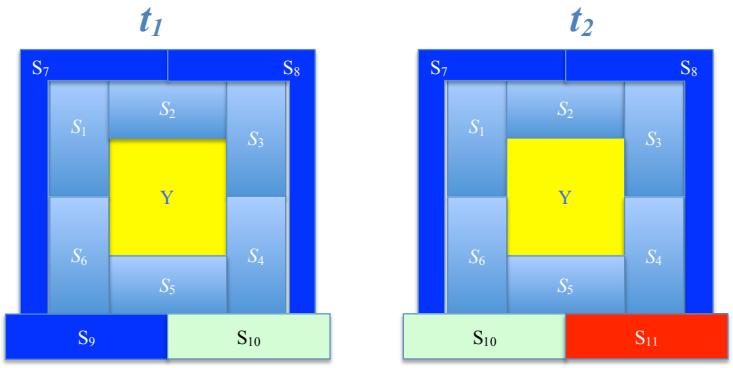

Figure 6.1

In Figure 6.1, the relative place of S_5 at t_1 can be characterized as "between Y, S_4, S_6, S_9, and S_{10}." But, at t_2, no such relative position exists. Thus, the starting point of the motion cannot be located at t_2. Hence, no measurement of the motion could be made at t_2. A corollary of this is that there is no possible way to measure the velocity of an object at t_2 either, for this requires an ability to give a geometrical description of the point of origination too. Thus, Cartesian theory becomes incompatible with the practice of mathematical physics. Clearly, it is no overstatement when Domski identifies this challenge as the "most devastating" of those found in "de Grav."[44]

In summary, Newton contends that Descartes' position robs us first of our empirical experience, second of the geometrical understanding of motion, and third of physics. These are untenable consequences. Thankfully, Newton offers the comforting news that we are not beholden to the Cartesian view; there is a theoretical loophole. However, I will show that the only way to take advantage of this loophole is to admit the existence of generic extension. Thus,

[44]Mary Domski, "Newton's Empiricism and Metaphysics," in *Philosophy Compass* 5/7 (2010), 525–534. A similar reaction is found in Domski's "Newton and Proclus-Geometry, Imagination, and Knowing Space," in *The Southern Journal of Philosophy* 50.3 (2012), 392.

we obtain the ontological structure needed to ground the epistemic possibility of providing true motive descriptions that correspond with our experiences. Physics is thereby restored. In other words, according to Newton, it is necessary for one to postulate the real existence of absolute space, which is identifiable as extension disconnected from any actual body.

6.II.D Newton's Conception of Extension

Newton recognizes that the identification of extension and body is a significant influence on Descartes' doctrine of motion. Descartes attempts to demonstrate this identity in II.4 and II.11 of *The Principles* when he argues that, by mentally removing all of the changing qualities from our understanding of a particular body, one inevitably uncovers the essential nature of the idea of body itself. The result of this abstraction is the discovery of the essential characteristics of body (to be extended in height, depth, and width).[45] If this conclusion could be undermined, then the possibility of having an extended region of space that is not identifiable as a body remains.

Newton offers a distinct definition of extension, contending that it be neither a substance (since it is not absolute in itself and has no effectual power) nor an accident (since one can easily conceive of extension without also imagining the presence of a substance). Rather, he continues, extension *is an emanative effect of God and an affection of every kind of being*.[46] To substantiate the characterization, Newton argues that identifying body and space is conceptually impossible.[47] To support this, he first proposes that every possible shape of every possible size must be able to

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[45]"The nature of matter, or body considered in general, consists not in its being something which is hard or heavy or coloured, or which affects the senses in any way, but simply in its being something which is extended in length, breadth, and depth" (Descartes, *Princ.*, §II.4, 40).

[46]Newton, 21. I admit that the definition is offered a bit abruptly. It will be fleshed out over the next few paragraphs.

[47]One may wonder what Newton's correction of Descartes conception of body is. Newton would say that Descartes failed to see that solidity, or impenetrability, is also a necessary feature of body. But since there are penetrable regions of space, it cannot be identified as body. For a full account, see *de Gravitatione*, 27-33. For a clear account on Newton's view of body, especially with regard to some conceptual challenges that Newton's presentation of the account gives rise, see Hylarie Kochiras' "Newton on Matter and Space in *De gravitatione et aequipondio fluidorum*," Presented June 14, 2012 at the *7th Quadrennial Fellows Conference of the Pittsburgh Center for Philosophy of Science,* convened at Mugla University.

be accounted for via the concept of extension. Since there is no limit to the possible magnitude of a given shape, extension must be understood as potentially infinite.[48] There is no clear incoherence in this conception. However, the idea of an infinitely extended body is incoherent; for the concept *body* essentially includes the attribute *boundary*. Hence, because extension is essentially boundless and bodies are essentially bounded, it follows that these notions are incompatible. Therefore, it cannot be the case that body is coextensive with extension.

A corollary of the fact that bodies are essentially limited is that they must be limited by something. Now, some bodies may be limited by others, as is the case in a plenum. However, as each of the limiters in a plenum is body, and so must be limited as well, it stands to reason that there must be some empirical reality that transcends the total magnitude of bodies. Newton identifies this with absolute space. Since absolute space does not have the boundedness restriction that prevents body from being identified with extension itself, it is possible to identify absolute space with extension itself. In fact, since Newton sees no clear distinction between his concept of absolute space and his idea of extension, he comfortably accepts the identification.

It remains to be seen why Newton relates extension itself (i.e., absolute space) with God. Perhaps he is attempting to avoid unorthodoxy.[49] That is, if God is not identified with space, then

[48]This is not the only argument Newton offers for the infinite extensional character of space. He also discusses this topic in a series of correspondences with Richard Bentley between 12-10-1692 and 2-25-1693. One of his more forceful arguments is that, were space not infinite, the universe would collapse on account of the mutual attraction of bodies. That is, if the outermost bodies of a finite spatial universe had nothing to pull towards beyond them, then all of their attractive energy would proceed inwards towards the center of the universe and, thus, the inner boundary would be pulled closer to the center as well. But then those bodies at the new boundary would have no outer body to sustain their outer positioning, and so they too would collapse inward. This process would continue until the whole universe were collapsed into one completely dense ball of matter. See *Correspondences*, Vol. III, 233.

[49]This is not the only possible solution. There are other, more philosophically minded possibilities that are discussed by Hylarie Kochiras in her "Gravity's Cause and Substance Counting: Contextualizing the Problems," in *Studies in History and Philosophy of Science* 42 (2011), 177-178. However, those are no less speculative than my proposal. A challenge to my view could be made that identifies Newton's free-thinking spirit as prohibitory towards committing to an orthodoxy for the sake of being orthodox. For example, Newton is believed to have rejected belief in the Trinity, which is historically considered among the most significant orthodoxy-determinants in Christianity (e.g., see Howard Stein, "Newtonian Space-Time," in *Texas Quarterly* 10 (1967), 197). I would answer that one could make the case that the doctrine of the Trinity is not obviously stated in the Christian Scriptures (which Newton is

space must be created, given the Christian beliefs that (i) God is creator of all non-divine things, and (ii) God is the only divine thing. But this is problematic, for if extension were created, then, either God is not omnipresent by nature (only by accident) or he must have created a part of his own nature when he created space. Neither implication seems acceptable under Christian theism. Thus, in order to retain orthodoxy, it is necessary to identify space, in some way, with God's infinite being. However, this position is a potential threat to orthodoxy as well, given that Christian theism must be disassociated from the likes of a Spinozistic monism, which strictly identifies God with space.[50] So Newton tries to construe space as identifiable with, but not identical to, God. He thinks he retains the distinctness of these beings by construing space as an essentially powerless emanation of divine being while construing God as essentially powerful.

In summary, as an emanative effect of God, space is distinguishable from God, although it retains some of his non-active features. And it does so without being characterizable as a separate substance.[51] Thus, "extension is eternal, infinite, uncreated, uniform throughout, not in the least mobile, nor capable of inducing change of motion in bodies or change of thought in the mind."[52] In a number of places, Newton speaks of this emanation as "the sensorium of God."[53] [54]

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committed to as an authority) and is definitely invisible to reason, whereas omnipresence is clearly stated in the Scriptures and is available to reason through certain lines of argumentation that are very common to theism.

[50]Stephen Toulmin historically grounds such a worry: "To Henry More and Joseph Raphson it seemed that Space must be one aspect of the Deity, namely, His immensity; both God and Space were (they argued) infinite, eternal, incorporeal, and immutable, and it was not to be supposed that the Universe could harbor two separate, independent, and distinct entities having all these characteristics in common." See his "Criticism in the History of Science I," 6.

[51]I do not presume that this account is fully developed. Such a project would require a massive effort, one need only consider the vast collection of recent works attempting to give a metaphysical account of Newtonian space. For example, see Stein's, "Newtonian Space-Time," Robert DiSalle, "Newton's Philosophical Analysis of Space and Time," in *The Cambridge Companion to Newton*, ed. by Cohen and Smith (Cambridge: Cambridge University Press, 2002), 33-56, Graham Nerlich, "Can Parts of Space Move? On Paragraph Six of Newton's Scholium," in *Erkenntnis* 62 (2005), 119–35, Nick Huggett, "Why the Parts of Absolute Space are Immobile," in *The British Journal for the Philosophy of Science* 59 (2008), 391-407, and a pair of articles by Edward Slowik, "Newton's Metaphysics of Space: A *"Tertium Quid"* betwixt Substantivalism and Relationism, or Merely a "God of the (Rational Mechanical) Gaps"?," in *Perspectives on Science* 17.4 (2009), 429-456 and "Newton, the Parts of Space, and the Holism of Spatial Ontology," in *HOPOS: The Journal of the International Society for the History of Philosophy of Science*, 1.2 (2011), 249-272.

[52]Newton, de Gravitatione, 33.

6.III. WHY NEWTONIAN NATURAL PHILOSOPHY IS NOT PLENUM-FRIENDLY

As it stands, there seem to be two conflicting strands of Newtonian argument concerning space and void. The first is that expressed by the description of an aethereal substance that functions as a cause of universal gravitation, permeating all of infinite space. On a construal of this sort, a materialistic rendering of space is most natural (since the effect to be explained is a mechanical one), and so a plenum view seems to be a possible alternative. The second strand is that expressed by describing space as an emanative effect of the divine substance. On a construal of this sort, an immaterialist rendering of space is the more natural one (since the object that space is identified with is thought immaterial). Obviously, both cannot be held at once. I aim here to substantiate the latter construal by showing that the first is subject to some serious mechanical challenges.

In this final section, I consider Newton's apparent reconsideration of reality as possibly consistent with a plenum. The driving force of this theoretic expansion was Newton's apparently newfound appreciation for the conception of a *non-fluid* aether. I explain why the view that

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[53]It is not all that clear what a sensorium is. In one place, Newton speaks of the sensorium as the sense organ itself (see Newton's 4-3-1673 letter to Oldenburg in *Correspondences*, Vol. I, 264ff). In another place he implies that a sensorium is more internal than the sense organ, being posterior to the optic nerve (see Newton's 12-7-1675 letter to Oldenburg in *Correspondences*, Vol. I, 376). The latter opinion is reflected very late in his work when, in Query 15 of the *Opticks*, he identifies the sensorium as distinct from the brain, nerves, or surface of the eyes. It is something else, that upon which a visual image is cast. Thus, we might think of it metaphorically as an immaterial visual screen in God's mind – space becomes the schema of God's mind for conceiving physical events. The most famous statement of the sensorium comes from Query 31 of the *Opticks*: God "being in all places, is more able by his will to move the bodies within his boundless uniform sensorium, and thereby to form and reform the parts of the universe, than we are by our will to move the parts of our own bodies. And yet we are not to consider the world as the body of God, or the several parts thereof, as the parts of God. He is an uniform being, devoid of organs, members, or parts, and they are his creatures subordinate to him, and subservient to his will; and he is no more the soul of them than the soul of man is the soul of the species of things carried through the organs of sense into the place of its sensation, where it perceives them by means of its immediate presence, without the intervention of any third thing. The organs of sense are not for enabling the soul to perceive the species of things in its sensorium, but only for conveying them thither; and God has no need of such organs, he being everywhere present to the things themselves" (Newton, *Opticks*, 403).

[54]For more detail concerning Newton's understanding of the relation between space and God, see J. E. McGuire's translation of an unpublished original source manuscript on the subject: "Newton on Place, Time, and God," 119-123 as well as his historically enlightening interpretive project, "Existence, Actuality, and Necessity: Newton on Space and Time," in *Annals of Science* 35 (1978), 463-508.

aethereal substance fills the spatial plenum seems seriously problematic, enough to abandon the mechanical project in favor of the traditional action-at-a-distance interpretation of gravity.[55] [56] After this, I make my argument against the pro-plenum turn. Then, I show that there are textual reasons to think that Newton saw a pro-plenum turn as problematic as well, which is perhaps one reason why he seems just as confident in his "arm-of-God" interpretation of astronomical motion as he is in the likelihood of the proposed mechanical account.[57] Lastly, I identify the concern that admitting of an aethereal plenum would cost Newton his advantage over Cartesianism.

First, the postulation of non-fluid aether is inconsistent with Newton's developed doctrine of terrestrial gravity.[58] I support this in two steps. First, I show that the non-fluid aether must be a

[55]While this is the traditional interpretation, it is not obvious that it was Newton's own. He seems to have struggled greatly with explaining his idea of gravity. For a textual exegesis of his struggle, see Kochiras, "Gravity's Cause and Substance Counting: Contextualizing the Problems," 175-183.

[56]Mine is not the only work that argues for the inconsistency of a mechanical-aether account of gravitation. Hylarie Kochiras ("Gravity and Newton's Substance Counting Problem," in *Studies in History and Philosophy of Science* 40 (2009)) identifies some problems for the view. First, a "medium with sufficient resistance to move the planets by impact would cause deviations from Kepler's idealized elliptical orbits and, contrary to observations, would eventually bring the planets to a stop" (270). Further, material mediums are subject to gravitational laws as well, and this leads to an explanatory regress problem (276-277). Kochiras considers the possibility that Newton's aether is understood as an immaterial substance in order to evade this criticism, but contends that the hypothesis is not subject to empirical test, and so is inaccessible given Newton's other commitments (277-288). The hypothesis also leads to severe epistemic and metaphysical problems (278-279). Eric Schliesser challenges Kochiras' reading of Newton in "Newton's Substance Monism, Distant Action, and the Nature of Newton's Empiricism: Discussion of H. Kochiras 'Gravity and Newton's Substance Counting Problem'," in *Studies in History and Philosophy of Science* 42.1, 160–166. Kochiras incisively strikes back in "Gravity's Cause and Substance Counting: Contextualizing the Problems, 169–172.

[57]Technically, the arm-of-God explanation was introduced as a way to explain why universal gravitational pull did not result in a collapsed universe. It was a prohibition on gravity's full effect. Thus, the arm-of-God approach is not appropriately identified as a cause of gravity. However, I think that this approach actually undoes the need for a mechanical aether view anyway. Once you postulate God as a cause for the effect, why multiply the number of causes involved? In other words, mechanical aether alone is not sufficient to explain gravity, but the divine arm is. So either we postulate aether and the divine arm or just the divine arm. As I see it, if God is brought into the picture, and if the universal aether is not useful for explaining additional phenomena, then aether is dispensable. This seems to have become apparent to Newton late in his career. See Query 31 of *Opticks*, where he considers a construal of gravity as a non-natural (superadded) active power put into matter by God. Kochiras argues that this would be an inconsistent position ("Gravity's Cause and Substance Counting Problem," 273-274). Whatever the case, explaining gravity is clearly one of the unsolved riddles for Newtonianism.

[58]Some have argued that proposing a plenum is inconsistent with universal gravity, as it would negate the possibility for planetary motion, a significant problem for a Newtonian physicist. But this argument depends on the supposition that all matter is equally dense, which I do not think is easily defendable. In fact, McGuire contends that there is reason to believe that Newton rejects this supposition and opens the gates for the non-void view. I don't think such a move is available to Newton, given his other belief that all matter is essentially the same. In any case, since I have already laid down the conceptual infrastructure for a more moderate contention, one that shows the supposition of a

mechanical substance if it is to be entertained by Newton as an empirical cause. Then I propose that Newton's aether does not permit the mechanical effect involved in the gravitational relation.

Concerning the first point, the conception of a non-fluid material aether is ambiguous; for it is not clear how the designation "non-fluid" should be understood. At a glance, it seems open to a non-mechanical interpretation. However, Newton cannot consistently construe "non-fluid" as "non mechanical" since he was steady in his belief that only hypotheses subject to testing by experiment are sufficient for scientific inquiry.[59] J. E. McGuire expands on this when he conveys that, in order for an object to be counted as a scientific phenomenon, it must possess certain causal properties, most importantly it must be able to offer resistance.[60] Hence, Newton's designation of "non-fluid" is best understood not as a rejection of its mechanical efficacy, but as a rejection of a certain kind of mechanical character, the Cartesian notion of aether as swirling vortices which carry interstellar bodies through outer space. Thus, below, I give an account of this mechanical, yet non-fluid conception of the Newtonian aether.

I take the account of gravitational aether to be construable as follows: Non-fluid aether is not directly mechanical with respect to the astronomical bodies, but it is directly mechanical with regard to something else, namely, other non-fluid aethereal systems. In short, gravitation may be mechanically construed as one system of aether getting interrelated with another system of aether and causing the pair of systems to remain in a relatively stable, albeit dynamical, local state. Consider the following diagram:

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plenum to be inconsistent with Newtonian philosophy, I ignore the argument concerning universal gravitation here. For more detail concerning the more general argument, see J. E. McGuire, "Body and Void," 208-214 and 230-231.

[59]In his 6-10-1672 letter to Oldenburg for Pardies, he writes "Hypotheses should be subservient only in explaining the properties of things, but not assumed in determining them; unless so far as they may furnish experiments. For if the possibility of hypotheses is to be the test of the truth and reality of things, I see not how certainty can be obtained in any science; since numerous hypotheses may be devised, which shall seem to overcome new difficulties" (Newton, *Correspondences*, Vol. I, 106). This is reiterated in his much later letter to Fontenelle where he distinguishes natural from hypothetical philosophy (quoted in §I.A above).

[60]McGuire, "Body and Void," 237-238.

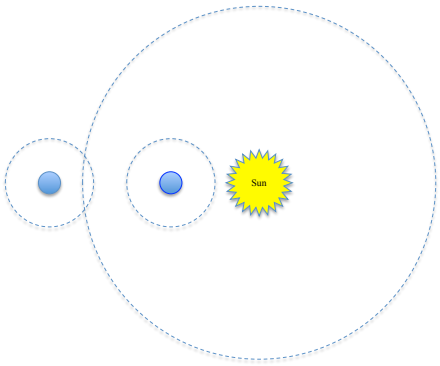

Figure 6.2

In this diagram, the large central body is the sun. The other two bodies represent any objects that lay within the field of influence of the sun's gravitational pull. The gravitational field of the sun is represented by the large dotted circle, and it should be construed as full of Newton's non-fluid aether. Each of the planets has its own non-fluid aether field of influence as well. This follows from the fact that Newton considered aether to be the cause of the cohesion of composite bodies through the exertion of pressure induced when aether endeavors towards the interstices of the body in question. The body in the diagram that is entirely encompassed by the aethereal field of the sun is any body that is not among the outermost bodies affected by the gravitational pull of the sun. The outer body in the diagram is any body that is uncontained (geometrically) by the aethereal field of the sun, but whose own aethereal field has an overlap with the sun's. Thus, this object represents the farthest objects that are still affected by the sun's gravitational pull.

What this diagram is primarily meant to represent is that there are multiple systems of aether that are involved in the gravitational goings-on of the universe, and each one maintains a primary relation to one preferred object. However, when these systems overlap, it is supposed, they have an indirect influence on the planets to which they "belong" by getting conjoined with one another. But I am not convinced that this can happen given the characterization of Newton's aether in §6.II.A. For if aether has a natural tendency (*vis inertiae*) to move towards the nether

regions of rigid objects in general, then, at the areas where the aether fields overlap, we should not find that the aethereal particles remain overlapped by pulling against one another (thereby forming a steady union). Rather we should find that the individual aethereal particles involved undergo a directional change, so that those regions of aether that belonged to the sun's field but got "behind the wall" of the smaller bodies field would change their endeavor state from being towards the sun's interstices to being towards the other body's interstices. Likewise, the regions of aether that belonged to the smaller body's field but got "cut off" by regions of the sun's field would also undergo a change of their endeavor state and begin their procession towards the interstices of the sun. The resulting state would look like this:

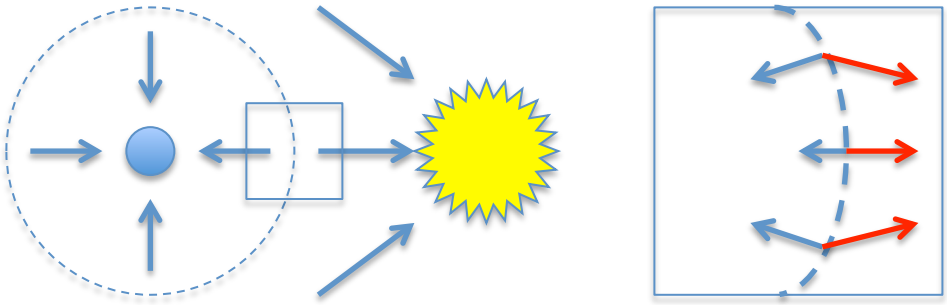

Figure 6.3

Of course, this interpretation is not conceptually necessary, but it seems to be the simplest way of understanding the flow of aether given Newton's prior commitments. The most relevant commitments that I have in mind are that (a) all matter is fundamentally the same, and (b) aether lacks a specific natural directionality, having only a disposition to reach the innermost interstices of *some* object. If Newton were to adjust his theory, allowing for mutually exclusive forms of aether (each designated to a particular object), then he could allow that every astronomical body has a set of aethereal particles specific to itself, and that these particles cannot change with respect to their object of affection. But this seems an unlikely move for someone, like Newton, who seems so averse to making any appeal to occult forces (unless they be God).

Perhaps one could respond that it is not actually the interlocking of aethereal fields that causes a gravitational effect, but rather it is the fact that objects get fully within the gravitational field of the sun that causes them to be held in place. On this interpretation, no objects affected by the sun's gravitational pull are not enveloped by the sun's aethereal field as in Figure 6.2 above. Instead, all gravitational interaction looks like this:

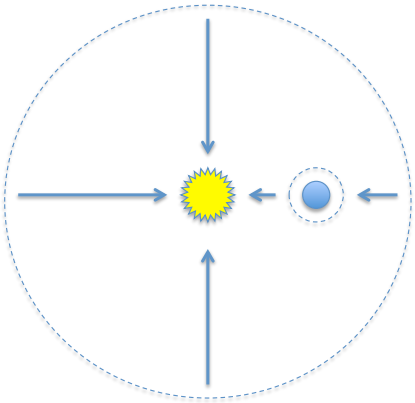

Figure 6.4

But even in this case, one wonders why the aether beyond the interstellar body and the edge of the sun's sphere of influence seeks the interstices of the sun, rather than that of the other body. Why, that is, does this aether hold that body where it is as it endeavors towards the sun rather than changing its own object of affection? If this circumstance is admitted as possible, then it is feasible that the body, along with its own aethereal sphere, could drift away from the influence of the sun's aethereal sphere at any time. In fact, this is likely.[61] Thus, the model would not be said to accomplish its primary role, to explain extra-terrestrial gravitation. But if the the changing of affections is not admitted as a possibility, then we fall into the aforementioned conundrum; that is, we must provide an account for why some aethereal regions belong to some bodies and do not change their natural allegiance.

[61]I envision that the aether, shortly after being subsumed, would seek the easiest path to the interstices of the interstellar body. Thus, it may roll around the outer edge until it found that path. This would swell the edge of the aethereal sphere that faces the sun, thus pushing the whole internal portion of the sphere outwards. Eventually, this outer edge of the sphere would reach the outer edge of the solar-aethereal sphere and allow it to easily break away.

From all of this, it can be seen that the postulation of a non-fluid aethereal plenum in order to explain universal gravitation is riddled with difficulties (given the other Newtonian commitments). These are solvable difficulties in principle, but not without some characterization of nature that involves occult entities or powers. Thus, given Newton's aversion to such characterizations, it stands to reason that he would seek to avoid such an account. Unfortunately, there are no direct statements of Newton that make this aversion explicit.[62] However, there are some textual evidences that are consistent with the pro-void interpretation of Newton's world-system from late in his career. First, in later passages in the *Opticks*, particularly in Query 28, Newton seems to reaffirm his belief that there is void.

> To make way for the regular and lasting motions of the planets and comets, it's necessary to empty the heavens of all matter, except perhaps some very thin vapors, steams, or effluvia, arising from the atmospheres of the earth, planets, and comets, and from such an exceedingly rare aethereal medium as we described above.[63]

Thus, even given the affirmation of interplanetary aether, there are admitted to be some regions that are for the most part empty with the exception of random vaporous material. Just in case any doubt remains, he immediately goes on to characterize his view on the matter as consistent with atomistic philosophy (the very school that Aristotle was at pains to challenge) and against mechanistic philosophy.[64] The second textual evidence comes from Newton's 1711 correspondence with Roger Cotes. In one letter, Cotes shows concern that Newton is "giving up

[62]There are some secondary source documents that support Newton's explicit rejection of a plenum around the time that he was writing the Optical Queries. For instance, in a memorandum from 12-21-1705, David Gregory says of Newton that "he believes God to be omnipresent in the literal sense . . . for he supposes that God is present in space where there is no body, he is present in space where a body is also present." See Toulmin "Criticism in the History of Science: Newton on Absolute Space, Time, and Motion, II," in *The Philosophical Review* 68.2 (1959), 222.
[63]Newton, *Opticks*, 368.
[64]For an enlightening account of Newton's consistent adherence to a Morean conception of atomism, see Andrew Janiak, "Space, Atoms and Mathematical Divisibility in Newton," in *Studies in the History and Philosophy of Science* 31.2 (2000), 203-230. More recently, Eric Schliesser identifies Newton as being committed to a host of atomistic doctrines, including the affirmation of a vacuum ("On Reading Newton as an Epicurean: Kant, Spinozism and the Changes to the Principia," in *Studies in History and Philosophy of Science* 44.3 (2013), 420-424. Schliesser goes on, however to demonstrate many ways in which Newton is committed to a rejection of many central doctrines of classical atomism, specifically the atomism of Lucretius.

the cause to the patrons of a plenum."[65] He goes on to offer his recommendation for avoiding the implication. In response to these recommendations, Newton seems to appreciate the emendations, thus validating his apparent desire to avoid plenum-theoretic implications.[66]

Finally, the admittance of a non-mechanical, non-fluid aether would conflict with one of Newton's most strongly defended philosophical arguments, the argument from "de Grav" that extension cannot be identified with body. Undermining this would undo his fundamental criticism of Descartes, which I expect Newton would have taken as a crowning achievement of his life's work. Thus, I think, this implication would be too great for Newton to bear. Therefore, there seems to be many good reasons to believe that Newton should have retained, and did retain, a pro-void interpretation of space.

6.IV CONCLUSION

It is now clear that Newton, in order to be consistent, would affirm the existence of void, a place where no body is present. Thus, it is also clear that he is in a state of disagreement with Aristotle. In Chapter Seven, I use the data from this and the last chapter to show that the disagreement between Aristotle and Newton cannot be adjudicated by appeal to the object-sided features of empirical experience. Thus, I infer, they are locked in a state of incommensurability with regard to the question of void's existence.

[65]The letter is dated June 4th, 1711. Newton, *Correspondences*, Vol. V, 153.
[66]See the letters of Newton to Cotes from June 7th and June 18th of 1711. Newton, *Correspondences*, Vol. V, 155-156, 164.

CHAPTER SEVEN:
ARISTOTLE, NEWTON, AND INCOMMENSURABILITY

In this chapter, I show how the non-antirealist Kuhnian idealism developed and discussed in Chapters Two through Four can be applied to a real case of scientific disagreement, namely, to the debate concerning the existence of void. I begin in §7.I by showing how the ontology developed in Chapter Four is rich enough to undermine fundamental features of the Aristotelian model, as well as the most significant empirical argument used by Aristotle in support of his pro-plenum view. Hence, on a Kuhnian view, it is apparent that the raw empirical facts of nature, existence and distinguishability, can sometimes determine which theories are, in fact, scientifically applicable. An implication of the Aristotelian failure is that later physical theory, insofar as it is consistent with the raw empirical facts of nature, can be characterized as being preferable to the Aristotelian system.[1] In short, §7.1 serves to evidence the non-total-relativism contention that I make in Chapters Three and Four.

However, though Aristotle's system as a whole is shown to be unacceptable, it is not the case that *all* of his arguments against the existence of void have been undermined. Thus, in §7.II, I consider in greater detail the Aristotelian argument that survives the empirical challenges, namely the contention that "void" is an incoherent notion. In §7.III I develop a possible Newtonian response to this incoherence argument which, I think, successfully evades the Aristotelian challenge. Finally, in §7.IV, I argue that the disagreement between Newton and Aristotle is based upon inclinations and linguistic choices, which have been characterized as non-empirical elements (i.e., subject-sided conceptualizations) under Kuhnian idealism.

[1]For the interest of keeping this chapter relatively short, I do not make the case that Newton's system is, in fact, consistent with the raw facts. However, I do not think that there is any obvious point of incompatibility.

Now, incommensurability ensues only when disagreements rest solely upon subject-sided conceptualizations. In short, supposing that I have satisfactorily shown that Aristotle and Newton each commit to a view concerning void's existence and that I have shown that the justification for holding either of the opposing beliefs results from one's subject-sided commitments, then it should be acknowledged that these two great thinkers reside in an incommensurable state with respect to the issue at hand. And, thus, the conclusion of my project will have been reached.

7.I THE OBJECT-SIDED WORLD VS. ARISTOTLE

Given the empirical data available to those of us living in the twentieth century, it seems inappropriate that any reasonable person would promote Aristotle's entire view of nature. So if the Kuhnian model cannot either rule out Aristotle's system as a viable option for explaining the way that the object-sided world presents itself, or at least cannot require that one who wishes to maintain a breed of Aristotelian natural philosophy conduct a significant overhaul of the classical system, then we should infer that something is seriously wrong with the model. In this section, I argue that the Kuhnian model as I have developed it *can* demand either a rejection or an overhaul of Aristotle's physical picture. To accomplish the aim, I focus the reader's attention on two fundamental doctrines of Aristotelian science: (1) the five-element thesis and (2) the natural-direction-of-motion thesis. I show how problems that arise with regard to these theses taken in isolation lead one to recognize that the Aristotelian system of nature as a whole is unsustainable. Further, I show that an implication of this unsustainability is that Aristotle's empirical argument in favor of an interstellar plenum is not supportable by the actual empirical data.

7.I.A The Subject-Sided / Object-Sided Distinction

First, however, it seems worthwhile to get reacquainted with some important elements of the Kuhnian doctrine I have proposed. Recall that my rendering of incommensurability was able to avoid a charge of total-relativism because I was able to distinguish between the subject-sided and object-sided moments of common empirical experience. Now, according to that distinction, the object-sided moment was presumed to be univocally shared by all. So, if I am to objectively undermine Aristotelian natural philosophy, I must show that its problems arise on the basis of the object-sided moment. This is my aim in this section. To do this, I first recapitulate the distinction between object-sided and subject-sided moments of experience which was first introduced in §3.II.A and then developed in Chapter Four. Then, in §7.I.B and §7.I.C, I show how the failure of the Aristotelian doctrines discussed here is based upon evidence that is appropriately classified under the object-sided part of the divide. Next, after taking a deeper look at the Aristotelian incoherence argument against the possibility of void that was introduced in §5.II.E, and after characterizing what I take to be a solid Newtonian response in §7.III, I show, in §7.IV, that the disagreement regarding whether the void-theorist adopts an incoherent position rests not upon the shared object-sided features, but upon distinct, yet reasonable, subject-sided ones.

On the version of Kuhnian idealism that I have developed, the object-sided moment of an empirical experience is immediately caused by the world of physical stimuli. That is, this moment consists solely of information that is grounded in real existent distinguishables involved in a complex system of seemingly reciprocal interaction. This complex system has been referred to as the object-sided world. As implied above, the object-sided moment is entirely objective – there is nothing in it which owes its presence to the perceiving individual. Furthermore, there is only one object-sided world in Kuhnian theory, and this world has a fundamental ontological

status. On my view, I presuppose that human observers have direct access to the object-sided world via their faculties for sensation, nervous system, and neuronal network. I also take it that personal interaction with this world is common and happens in a mechanical fashion. However, on my view, only a small set of properties, including existence and distinguishability, are directly conveyed to human observers through these means. Thus, scientific concepts and categories are not grounded in the object-sided moment of empirical experience. Therefore, though scientists do interact with this world insofar as they observe it, whenever they are engaged in scientific puzzle-solving they are not dealing *solely with* object-sided concerns.

I have previously identified the non-objective elements as the subject-sided moment of experience. Like the object-sided moment, the subject-sided moment is considered to be based upon external reality, though not entirely so. That is, though the subject-sided moment is thought of as causally related to the object-sided nexus, its exact character is dependent upon the activity of the observer. In short, the subject-sided moment carries mental constructs that are intended as approximations of the true character of nature into common empirical experience. The Kuhnian identifies these mental constructs as members of the paradigm that one has chosen to adopt.[2] Most of the constructs, hopefully all of them for the scientist, are born in response to some impetus of the object-sided world. This is what I meant when I said that a subject-sided moment is thought of as causally related to the object-sided nexus. But, because the object-sided world does not communicate its character in the specific way that is representative of scientific conceptualization, but only insofar as its objects exist and are basically distinguishable from one another, it follows that there are a number of possible ways that one can respond to its influence. Hence, there are a number of possible paradigms that might fit the raw stimuli. Now, whenever

[2]Among the most important of these constructs are linguistic elements, which are found in the observer's taxonomic lexicon. Instances of these include terms used to designate an object as a member of some broad class of things (e.g., as a member of a species or as a property of an object).

the object-sided world is considered through the taxonomic lens of a given paradigm (its lexicon), we call the result a subject-sided world. It should not be surprising, then, that many such worlds can exist at once, albeit only in different observers at any given time. Nonetheless, on my rendering of Kuhnianism, each of the subject-sided worlds is constrained by the same existence and distinguishability conditions that are mechanistically conveyed to an observer via the stimulation of the object-sided world.

7.I.B The Object-Sided Resistance to the Five-Element Thesis

Now that the subject-sided / object-sided division has been reintroduced, we can consider some examples of the object-sided world resisting Aristotelian natural philosophy. First, it seems evident that the object-sided world no longer cooperates with the ancient conception of nature as being divisible into the basic elements earth, fire, water, air, and aether. Of course, this is not to say that nature does not present itself elementally. In fact, contemporary chemical theory maintains that there are 118 basic elements found in nature and that many of the traditional Aristotelian elements can be re-expressed using these more subtly defined concepts. Take water, for example. Water is no longer treated as fundamental. That is, it has proven to be possible to break water down into its constituent parts, H^2 and O, respectively.[3] For instance, modern engineers have developed a technological process, electrolysis, in order to separate the oxygen from the hydrogen in a water sample. This process has been used to help submarines to stay submerged, and thus to remain incognito, for much longer periods of time because it prevents the need for the vessel to resurface in order to obtain the fresh supply of oxygen needed to ensure the survival of the crew. The separation of water's oxygen from its hydrogen is found in nature as well. Plants take in water via a root structure and, through the photosynthetic process, hydrogen

[3]Further, neither of these elements is itself construable as watery substance, but both are better considered as airy substances (using the Aristotelian terminology).

is separated from oxygen and is combined with carbon in order to produce the starches and sugars which are necessary to a plant's natural development. The oxygen, as it is unnecessary for vegetative development, is released as waste.

Similar accounts can be given with respect to the elemental divisibility of air and earth as those "elements" are conceived by Aristotle. Thus, the soil is divisible into a number of distinct earthy elements such as potassium, silicone, and carbon, as well as a number of distinct airy elements such as nitrogen and hydrogen. Likewise, atmospheric air can be broken up into its constituent airy elements, primarily nitrogen and oxygen, though there is often small amounts of earthy matter such as carbon in it as well. On the other hand, the modern characterization of fire implies a more dramatic reconceptualization. For fire cannot be considered as either a mixture of substances like air or a compound substance like water. Rather, it is presently understood as a combustive *activity* – a chemical reaction that occurs when a specific complex of the modern fundamental elements arise, usually oxygen and some other gas. This reconceptualization proves important, as is shown below. Finally, aether has no obvious corollary in contemporary chemical theory.

One may wonder at this point what this account has to do with the object-sided world. That is, one may respond to my contention that object-sided data rules out classical Aristotelian doctrine by pointing out that the evidence I have used so far to challenge Aristotle's elemental doctrine concerns a later conceptualization of nature, not the object-sided moment. And so the concurrent challenge to traditional Aristotelianism is not an object-sided refutation. However, this response misses the significant point. Whether or not the characterization of nature that is purported via the modern theory of elements is or is not object-sided does not matter. What matters is whether (i) nature object-sidedly communicates itself as construable under a theory

that demands a significantly larger number of fundamental elements than are available under Aristotle's system, and (ii) Aristotle's elements turn out to be consistent with this construal. In other words, the significant issue is whether object-sided reality presents itself in the way that is amenable to the Aristotelian categorization. And it seems that it does not because the classical theory cannot allow that either (a) its elements are actually composites of more fundamental material elements, or (b) one of the basic elements (aether) does not seem to have an observable presence at all.

What's more, if the object-sided world were compatible with the Aristotelian model, then he should be able to save his theory by means of slight qualification. Thus, for example, perhaps Aristotle could try to loosen his notion of "element," identifying it not necessarily as a *basic* constituent of reality but, instead, allowing the term to accommodate a *complex* of basic constituents as well. Unfortunately, this approach would fall short of saving his view. Such a move can only account for the discrepancies that arise with regard to water, earth, and air. It does not account for the problem of fire being reconceived as a non-substantial activity. Nor does the modification account for aether's object-sided invisibility.

So reconceiving "element" to include composite substances does not entirely alleviate the trouble for Aristotle's elemental theory. Instead, more significant adjustments need to be made to Aristotle's natural taxonomy if the view is to be salvaged. But to make significant adjustments to one's natural taxonomy is to adopt a new paradigmatic system. This is because paradigmatic systems are distinguished by Kuhn in accordance with his No-Overlap principle, which maintains that having non-overlapping conceptual schemes is a direct result of having distinct paradigms. But to be forced to adopt a new paradigm on the basis of nature's presentation just is the result of having fallen object-sidedly short. Therefore, since there is no straightforward way

to adjust the Aristotelian model that allows it to account for all of the object-sided data that has led modern scientists to adopt the current theory of elements, it should be inferred that the object-sided world has seemed to undermine the Aristotelian five-element view.

7.I.C The Object-Sided Resistance to the Natural-Directionality Thesis

In addition to the failure of the five-element theory, it is also the case that Aristotle's view concerning the natural motive directionality of an object (based upon its unique elemental composition) has serious trouble when pit against the object-sided presentation of nature. This doctrine was integrally important for the Aristotelian critique of a pro-void position, so a failure here would be very significant towards leveling the theoretical playing field shared with pro-void theorists. Thus, in what follows, I detail the failure. A pair of results will be established. First, by showing the natural directionality thesis to be empirically unsustainable, I provide more support for the main claim of this section, that nature resists Aristotelian taxonomization. Second, by showing that the Aristotelian thesis is empirically unsustainable, it becomes clear that one should infer the failure of Aristotle's empirical case against void's existence. The breakdown of the empirical argument, however, does not undermine every argument against the existence of void given by Aristotle. For a non-empirical argument was given as well. Thus, this subsection paves the way for §7.II, where I attend to this argument in hopes of substantiating its theoretic force.

Recall that Aristotle contended that each of the elements has a natural principle of motive directionality – an elemental form. He held this view because observation seemed to show, with perfect regularity, that the distinguishable objects that are characterized as earthy substance move *towards* the universal center, the distinguishable objects that are characterized as fiery substance move *away from* the universal center, the distinguishable objects that are characterized as watery substance or airy substance move *laterally between* the earthy and fiery realms, and the

distinguishable objects that are characterized as aethereal substance move *circularly* beyond the terrestrial sphere. Aristotle's empirical inference concerning the natural directionality of distinct forms of material being seems reasonable given the evidence available to him in his time. For even today, if we limit our empirical concern to what we can directly observe from the surface of the earth (without the help of modern technology), these regularities still seem to obtain. However, Aristotle never had an opportunity to venture beyond the terrestrial sphere. He was unable to review the testimony of the astronaut who has watched an earthy object, when taken far enough from the earth's center, move away from that center. He was unable to analyze the rocks and dirt that have been taken from the surface of the moon to see that these objects, previously characterized as aethereal substance, are composed of the same kind of tangible material that constitutes the earth itself. Finally, he was unable to see that the "objects" characterized as fire, if brought to their supposed "natural" position (beyond the realm of the air), do not actually find a peaceful state of rest. Rather, they become extinguished.

This last phenomena is especially troubling for a committed Aristotelian. For Aristotle's teleological view of nature demands that material objects act for achievable ends that involve both a state of dispositional rest as well as the preservation of being. If fire is extinguished when it reaches its supposedly natural place of rest, then it would seem that fire's substantial form is naturally disposed to bring about its own destruction. According to Aristotelian metaphysics, though, a form does not continue to exist when its object is destroyed. Hence, treating fire as having a natural aim to move away from the earth's center, and thus to bring about its own destruction, conflicts with Aristotelian natural teleology. Therefore, the Aristotelian thesis that the fundamental elements have a natural directionality of motion cannot accommodate what we now know about the character of the object-sided world.

7.I.D The Failure of the Empirical Arguments Against Void

The failure of the natural directionality thesis is a serious problem for Aristotle's most significant empirical argument offered against void's existence: the argument concerning relative velocity.[4] This is the most significant of the empirical arguments because it is the only one that implies the necessity of an *extraterrestrial* plenum. And since Newton openly committed himself to the existence of a terrestrial plenum,[5] it is appropriate to devalue those Aristotelian arguments that are only concerned with terrestrial phenomena. Now, since the argument concerning relative velocity is the only one that concerns extraterrestrial phenomena, and since it clearly depends on the natural directionality thesis, it is right to infer that the empirical case against void is unsuccessful. All of this is supported below.

First, I quickly re-present the argument concerning relative velocity. I then explain why it is the case that the relative velocity argument depends upon the natural motion thesis. The argument from relative velocity is found in the following passage:

> We see that bodies which have a greater impulse of either weight or of lightness, if they are alike in other respects, move faster over an equal space and in the ratio which their magnitudes bear to each other. Therefore, they will also move through the void with this ratio of speed. But that is impossible; for why should one move faster? (In moving through *plena* it must be so; for the greater divides them faster by its force. For a moving thing cleaves a medium either by its shape, or by the impulse which the body that is carried along or is projected possesses.) Therefore, all will possess equal velocity. But this is impossible.[6]

In Chapter Five (§5.II.C), it was argued that the phrase "impulse of either weight and lightness" is to be identified as the speed with which a body proceeds towards its natural state of rest. It was also contended that an object has a unique natural impulse that is based upon its compositional character. This compositional character, along with the density of a medium, turn out to be the

[4]The argument was first presented in §5.II.C.
[5]This commitment was expressed in §6.II.A.
[6]*Physics* 216[a].12-21.

conditions under which objects are able to move at relatively distinct speeds. However, in the case of the motion of Aristotelian heavenly bodies, compositional character is not able to play a role in generating distinct velocities since all of the objects are supposed to be composed of pure aether. This thesis was held for two reasons. First, the heavenly bodies were considered to be composed of a non-earthy substance because they seemed to participate in a natural, non-linear (circular) motion. Second, they were considered to be constituted by a unique substance because they seemed to occupy a natural place far beyond that of the other elements. But if the heavenly objects are compositionally identical to one another, then they should not exemplify relative distinction in their velocities unless there is a qualitative distinction in the medium through which they are found to move. But they are, in fact, observed to move at relatively distinct velocities. Thus, a medium had to be presupposed in order to account for the difference.

However, it is now uncontroversial that at least some of the extraterrestrial bodies are constituted by earthy substance. We know this because of what we have learned from empirical investigation. The moon is an obvious example. What's more, Aristotle described the motion of the moon as orbital, rather than linear. This conjunction of observations proves problematic for Aristotle.

First, it is problematic because Aristotle's system demands that all non-aethereal motion is straight-lined with an aim towards a resting state. And since the moon cannot be construed as purely aethereal given the updated sensible evidence, it seems that non-aethereal motion can no longer be treated as essentially straight-lined. This contention, though, can be easily rebutted. For, it can be suggested that Aristotle need not commit himself to the view that simple earthy bodies move circularly. Instead, these bodies only *appear to move* circularly; but these appearances can be characterized as instances of complex events involving only straight-lined

motion. For instance, the apparently circular motion of the moon can be portrayed as a straight-linear descent of the moon towards the center of the earth, which is involved in its own straight-linear motion towards the sun, which is involved in its own straight-linear motion towards some other body or complex of bodies, etc. Such an interpretation is similar to a Newtonian construal of orbital motion. Thus, perhaps Aristotle can accommodate the discovery that an extraterrestrial body (the moon) is made of earthy substance with natural linear motion.

Nonetheless, granting this explanation still requires the abandonment of the Aristotelian model because a new problem arises. The reinterpretation implies that there are multiple centers towards which earthy objects can be drawn. Whereas it is admissible for an Aristotelian to treat the moon as being drawn towards the earth, since the moon itself is characterized as an earthy substance with the earth as the body towards which it is drawn, it is inadmissible to involve the earth in a motion towards another body. This is because all motion still must be explained as occurring on the basis of an object's formal disposition. But the earth's constitutive elemental substance is not sufficiently distinct from the moon's – they are both earthy objects. Thus, the matter of the earth should be seeking its own center (as does the moon) and so it should not also be in motion.

What's more, the problem is not avoided if we suppose that Aristotle was simply wrong about the center towards which earthy matter is drawn. For establishing another center does not explain the phenomena because what is needed is not a mere reconfiguration, but an addition. That is, relocating the universal center is not enough to explain the perceived motions because a *single* (non-moving) center towards which all earthy substance moves by nature would result not in an apparent orbital path of the moon with respect to the earth, but rather in the moon seeming to follow the earth (or the earth seeming to follow the moon) in a straight line towards the

distinct center that the earth and moon are both seeking. But this construal is not possible given the object-sided evidence. Thus, the empirical data demands more than one center towards which earthy substance is drawn. But, on the Aristotelian model, to have two earthy objects naturally moving in opposite directions implies that either these objects are composed of formally distinct material or motion is not a natural effect of elemental forms at all. But the object-sided world does not substantiate the first option.[7] Hence, this implies either that (A) motion is not a natural effect of elemental forms at all, or (B) Aristotle's system is in need of a new taxonomic construal. If (A), then the natural directionality thesis is abandoned and my claim here is satisfied. If (B), then the before and after versions of the model will fail to satisfy the No-Overlap principle, and so must be treated as paradigmatically distinct. But this is to invoke an incommensurable explanation of the data and to reject the classical understanding of the natural-directionality thesis. So the object-sided failure remains and, again, my claim is satisfied. Therefore, it is clear that this Aristotelian thesis cannot withstand the empirical evidence.

Thus, while Aristotle can escape the problem of orbital motion resulting from what we have learned about the object-sided world, he cannot do it without causing serious tension with regard to his other theoretical commitments. Hence, nothing short of a significant revision of his system can accommodate the raw empirical data. Since it is apparent that such revisions would be inassimilable under a strict, classical Aristotelian philosophy of nature, it is reasonable to infer that his system is object-sidedly false.[8]

[7]Besides, Aristotle does not have another elemental category to distinguish the earth from the moon once aether is disallowed.

[8]In hindsight, we can identify Aristotle's problem as the fact that he was never forced to consider the possibility that planetary motion is not a natural effect of the planet's constituent elements. That is, given the empirical evidence at the time, he had no reason to think that local motion would be better understood as a complex relation between a substance's mass and its proximity to other massive objects. Aristotle is disadvantaged because the expanded pool of raw natural data available to the modern-day observer shows that the regularity perceived by Aristotle, that earthy matter universally tends towards a single center, has dissolved.

Before closing this section, let's apply this finding to the relative velocity argument in a more direct fashion. Since the former solution to the relative velocity problem rested upon the truth of the natural directionality thesis, it clearly follows that the argument from relative velocity is severely weakened, probably destroyed. But, because the perceived differences in the relative velocity of celestial objects is easily characterizable on Newton's model,[9] where multiple centers are already in play, it can be granted that the object-sided data supports that model. Finally, because Newton's model does not demand the postulation of an extraterrestrial aethereal plenum, there is no longer any clear empirical reason to suppose the non-existence of void.[10]

In summary, the object-sided world will not allow itself to be fit into the limits demanded by the Aristotelian system as classically understood. And while any single doctrine that we have discussed may, in principle, be maintained by someone who *really* wants to uphold it, it seems that the system as a whole is empirically untenable. In fact, the features of the system that are central to the empirical arguments offered for the pro-plenum view prove to be among the most problematic. Thus, if Aristotle's critique of void theory is going to be upheld, it will have to come either by way of a new empirical argument that does not involve his problematic theses or by way of a non-empirical argument. It is unlikely that a new empirical argument is possible given the fundamentality of these doctrines to Aristotle's empirical system. Thus, the best chance that the Aristotelian has at promoting an anti-void view is to provide a non-empirical argument. We know that Aristotle has given such an argument, for he has claimed that the notion of "void" is seen to be incoherent once the nature of *place* has been given adequate attention. I now turn attention to that argument.

[9]That is, the model that explains distinctions in orbital speed is a function of the masses of a pair of objects as well as their relative distances from the observer.

[10]One might add to this an acknowledgement of the fact that there are a number of modern experiments that seem to have the empirical implication that void does not exist, e.g., the Michelson-Morley ether-drag experiments.

7.II ARISTOTLE'S ARGUMENT CONCERNING THE INCOHERENCE OF VOID

In this section, I summarize the Aristotelian argument for the impossibility of void that is based upon the supposed incoherence of such an existent.[11] Once this is accomplished, I identify and explain the significant justificatory assumptions that underwrite the argument and show that these underlying assumptions are reasonable (object-sidedly consistent). Thus, the main function of this section is to give dialectical support for the incoherence argument. In the following section, §7.III, I provide a dialectically supportive case for the avoidability of the incoherence argument given a distinct set of commitments.

7.II.A Restating the Incoherence Argument

The primary conceptual issue with the pro-void position, according to Aristotle, is that admitting of void's existence involves the substantiation of place. But to conceive place substantivally, leads to conceptual discord. In order to support his declaration, Aristotle identifies what he takes to be the four essential features of place and then considers which of four possible characterizations of place is most suitable, given those essential features. The four essential features of place are:

(1) Place contains things without ever being a part of them.
(2) The primary place of a thing is always identical to its magnitude.
(3) Place must always be separable from the things it contains (i.e., it can be evacuated).
(4) One place can always be spoken of in relation to another place.

The possible identifications of place are:

(A) The shape (or form) of an object
(B) The matter of an object
(C) The extension of an object
(D) The extremities of an object

[11]This argument was originally presented in §5.II.E.

Aristotle then rules out (A) and (B) as viable characterizations of place because matter and form are inseparable from their object whereas, according to (3), an object must be separable from its place. Moreover, he rules out (C) as a viable characterization of place since extension seems to really be a part of an object. That is, extension is not just a container of an object that can be separated from it. So (C) conflicts with (1) and (3). Thus, by reduction Aristotle infers that place is to be identified with an object's extremities. More specifically, place is identified as the *innermost motionless boundary* of a containing body at which points it contacts a contained body. The discord for the substantivalist arises because the innermost motionless boundary of a body is simply unable to be identified with anything substantial. And this is the case because (a) the *exact nature* of an innermost motionless boundary is contingent with regard to a number of extrinsic features (for instance the pliability and density of the surrounding body), and (b) to be contingent upon another with respect to one's *exact nature* is to have an accidental mode of existence, which is contrary to being substantial by definition.

7.II.B The Assumptions Under the Incoherence Argument

Now that the incoherence argument from §5.II.E has been re-presented, the assumptions underwriting the argument must be revealed. There are a number of questions that can be asked that prove helpful in exposing the assumptions. As I see it, the most pressing questions are the following:

(Q_1) Why does Aristotle identify the essential features of place as those listed?
(Q_2) Why are the possible identifications of place limited to the four presented?
(Q_3) What, exactly, is the *exact nature* of place?

The remainder of this section unfolds by addressing each of these questions in turn.

7.II.B.1 The Essential Features of Place

When Aristotle introduces the four features of place, he admits that he is taking each of them for granted.[12] But I want to put pressure on his presumption in order to see what support could be garnered in favor of such a move. Since only features (1) and (3) are supposed to prove troublesome for the substantivalist view, I pay attention only to the potential support that can be developed for those features. Thus, I do not engage in a consideration of features (2) and (4). In addition, I must point out that the Aristotelian conception of place discussed here seems to favor an absolute rendering of "space."[13] Because such a rendering does not entail any problematic distinction between Aristotle and Newton, I do not critically assess it. However, there are alternatives to this conception, most notably the relative view supported by the likes of Leibniz. Any attempt to give a full analytic rendering of the term "space" and the corollary notion "place" would be required to address that position. But this is not my aim here, so I pass over the task.

To begin, consider feature (1), "place contains things without ever being a part of them." Why would one be inclined to take such a statement for granted? Aristotle hints at a possible explanation when he contends that "place" is a legitimate notion of concern only because things are perceived to be in motion.[14] At first blush, the connection between place and motion does not seem obvious at all, but I think that contemplating the subtle admission provides some insight into Aristotle's view. Conveniently, the idea can be nicely developed with a thought experiment.

Imagine that there are two objects, say a pillow and a ball that rests upon it. For the sake of argument, let's suppose that these are the only two objects in the material universe. Also, suppose that there is no spatial expanse in which they are situated; that is, there is no extension

[12] *Physics* 210^{b} 34-35.
[13] I take this as evident because I interpret Aristotle as allowing that something can change its place even if no other object exists by which to measure the change. Thus, change of place is not a relationally dependent notion.
[14] *Physics* 211^{a} 12-15. See also 208^{b} 1-8.

beyond the limits of the objects themselves. Further, let's suppose that neither one is, or could ever be, involved in any sort of motion. In this scenario, is there any need for a notion of place? In one sense, it seems that there is. For if we wanted to give an account for the fact that there is no extensional overlap between the substance of the pillow and the substance of the ball (that they are, in fact, two distinguishable objects), then it seems that we could do so by characterizing their relative positions. We can accomplish this characterization by distinguishing the position of the pillow (P^{pillow}) from the position of the ball (P^{ball}). But is relative positioning really what we mean to identify when we speak of an object's place? I don't think that it is. To explain my doubt, I'll continue on with the thought experiment.

Let's now expand the universe out from the limits of the pillow and ball. For the sake of simplicity, consider this new, expanded spatial realm as mechanically inconsequential – that the space between the boundaries of the universe and the boundaries of the pillow and ball cannot exert any force on the pillow and ball.[15] Now, imagine that the pillow and the ball are put into motion at exactly the same rate in exactly the same direction. In this case, neither P^{pillow} nor P^{ball} should be characterized any differently than in the first scenario since these are the only objects in our otherwise empty, albeit spatially expanded, universe. Thus, if it were the mere relational features of these objects that is implied by the common conception of place, then we should be inclined to say that these things remain in their places. This is clearly not how the term is commonly used. Thus, we must have in mind by place something distinct from a mere relational position of some object with respect to another. Rather, it is clear that, when we refer to an object's place, we are concerned with its position in a non-relative sense.

[15]I make this supposition to avoid any worry that the concept of aether is being grandfathered into the argument. That is, because the conditions I am attempting to justify here are supposed to be used as support for the inference that no void exists, let us not make the evidence for a material space obvious by giving it obvious causal efficacy.

To see more clearly why Aristotle saw fit to put motion and place into close relation, I suggest a couple of additional modifications on the scenario. First, let's return to the original version, where the pillow and ball are not in motion and the universal expanse is shrunk to the limits of these objects. Second, let's remove the ball from the scenario altogether and retract the spatial limits to those of the pillow alone. In this variation, the pillow retains geometrical extension. But is it *in a place*? To characterize it this way does not seem absurd, but it does seem superfluous. For, if the pillow could never leave the place, then the concept lacks utility. Now, let us re-expand the spatial limits of the universe again, so that the pillow no longer takes up the whole of it. Does it now make more sense to possess a concept such as place? It clearly does. Even if we do not suppose the pillow to actually move, the mere fact that there are distinct geometrical regions that the pillow could, in theory, fit into seems to be enough reason to establish the utility of the concept. From this we might infer that the conceptual possibility of motion is sufficient for introducing a useful notion of place into one's scientific vocabulary.[16]

So place is meaningful only in a scenario where the conceptual possibility of motion is acknowledged. However, it is not immediately clear that place is construed both as distinct from the object and as a container of the object as is stated in (1). For the possibility of motion does not necessitate the presumption that leaving one's place is actually possible. That is, it may be allowed that the place of a moved object accompanies the object through the transition. Hence, in order that (1) be fully grounded, it seems that (3) is necessary. So I now support the commitment to that feature of place. Once this has been developed, it should be granted that Aristotle is reasonable in upholding both features (1) and (3) as essential to the notion of place.

[16]One might be inclined to offer a challenge here. For example, it could be argued that one need not consider the possibility of motion in order to make mental use of the empty regions of space. Instead, it is enough to suppose that the pillow is instantaneously displaced without motion. However, for Aristotle a change of any sort is considered motion. So an appeal to the possibility of motion just is the claim that "things could be situated differently."

So feature (3), that "place must always be separable from the things it contains," is very important for the support of the Aristotelian position. In order to retain interpretive consistency with (1), I take it that "separability" is best understood as a conceptually determined possibility. For just as it seems wrong to suppose that the pillow needs to have actually moved from a former position in order that "place" be considered a valuable notion, likewise, it seems strange to suppose that the idea of abandoning one's place is sensible only after the fact. But is it the case that the abandonment feature is a natural implication of a change of place? I think that it is.

First of all, if there is no abandonment involved when a thing changes its place, then what becomes of the old place? The only alternative explanation is that place follows its object. Thus, in our example, the place of the pillow prior to its movement would become contained under a new place, as if it were something that persists along with the pillow under the limits of the new containing place. In such a case, the moving pillow would be construed as a place-collector, accumulating new containers at every location to which it goes. Perhaps this is not an impossible characterization, but it is certainly odd. What's more, it is not clear that the term retains linguistic value when used in this way.

In addition, there are a number of puzzles that seem to accompany this characterization. For example, if an object's former places travel with it, what do we make of the possibility that an object could reverse course, returning to the region of the expanse from which it came? It feels natural to suppose that there must be a place awaiting its return. But is this a new place? It seems obvious that it would have to be; for if it was just a re-creation of the old place, then, prior to the completion of the object's return, a single place would be describable as multiply located. Also, the entirety of the motion would amount to traversing a distance between $Place_x$ and $Place_x$. But this way of expressing the matter just seems inappropriate since when we talk about the

traversal of any distance we naturally take this to be the movement from one place to a distinct one – not from one place to itself. Now, if one were to reject the abandonment thesis and this exact-recreation construal, then he must suppose a new place to have been brought into being. But if this new-creation construal is correct, then it seems reasonable to inquire into how the development came about. Should we imagine that places are spontaneously recreated whenever an object and its original place abandon the spatial region from which it had moved? Or can a region of the spatial expanse persist with no place being present? Again, such proposals strike me as very strange.

Such head-spinning worries seem to imply that there is something wrong with the notion of a non-evacuable place. Therefore, it seems clear that Aristotle is well within his epistemic rights to identify features (1) and (3) as part of any meaningful conception of place. Are they absolutely essential, in the sense that one could never possess a notion of place unless she were to first admit the possibility of motion and the abandonment of place? No, I don't think that this is so. But it is certainly very difficult to entertain a non-evacuable version of the concept as being scientifically valuable. And it is definitely not how we use the term commonly. Thus, the first question, "Why does Aristotle identify the essential features of place as those listed?", has been satisfactorily answered and the justification for upholding the features that Aristotle does is found to be quite reasonable, as it seems to be usefully applicable to the world as we presently conceive of it. Hence, we can now move on to consider the second question, "Why are the possible identifications of place limited to the four presented?"

7.II.B.2 The Possible Characterizations of Place

Is there any good reason to suppose that "place" must be identified with either (A) the shape/form of an object, (B) the matter of an object, (C) the extension of an object, or (D) the

extremities of an object? Within this question, there are actually two distinct inquiries. First, why are these four options selected as the possible candidates? Second, why does Aristotle take these to be the only viable candidates? In short, it stands to reason that, supposing this to be a false quad-lemma, the incoherence argument of Aristotle would not go through. But if there is some solid justification for these assumptions, then perhaps the argument should be taken as plausible.

I begin by giving an account concerning why Aristotle may have proposed these specific options.[17] First, it must be admitted that place, whatever its nature must be, is some kind of limit. This does not seem objectionable. Now, if something is a limit, it is either intrinsic or extrinsic to the limited object. If it is extrinsic, it will fall under (D). If it is intrinsic, there are other possible divisions that can be made.

First, recall that, for Aristotle, all material objects are hylomorphic – they are composed of form and matter. Thus, if the limit is intrinsic, it must be based upon one of these principles under an Aristotelian interpretation. Now form is the unifying principle of a hylomorphic compound, as well as the ground for the exact character that the informed matter takes. If we were concerned to provide a full ontology here, we would also discuss the powers for action and passion that form establishes in the object of which it is a constituent. But since these concerns transcend our present worry, which is to consider only the extensional character of an object, then the only possible effect of the form that we are directly concerned with is the possibility that it designates an object's shape. Hence, there is no need to make further distinctions on the side of form. As a result, (A) is grounded as an option.

Matter, on the other hand, is the principle that accounts for the possibility that a single form be multiply individuated. In other words, matter is construable as a metaphysical principle that serves as the backdrop for a magnitude containing a form in some particular region. Now

[17]The following is partly adapted on the basis of *Physics* 209[b].

magnitude can be construed in either of two ways, either materially or generally (i.e., abstractly). If considered materially, we arrive at option (B). If abstractly, option (C). This seems to bring a completion to the relevant divisions that can be made concerning the intrinsic limitations of an object under a traditional Aristotelian hylomorphism. Hence, it seems that these four options, in fact, constitute a solid list of possibilities given the metaphysical base of the Aristotelian system.

But are these the only options that *should be* considered? I can immediately conjure up at least two ways to expand the list of possibilities. First, one could call for a further division of the "extrinsic" category, perhaps by mirroring the division found between matter as either a material magnitude or an abstract magnitude. Thus, one might contend that an extrinsic limiter could be either material or abstract. Now Aristotle would clearly reject such a possibility; for him, to be an extrinsic limiter of the physical extension of another is to be an exerter of physical force upon the extensional boundaries of the other. No abstract object is capable of being physically efficacious in this way for Aristotle. This response may not be fully satisfying as an explanation, but it is not easy to counter.

Secondly, one could challenge the hylomorphism of Aristotle, arguing that his general ontology is defunct. I suspect Aristotle would be more open to this challenge, though he would likely take the burden on the challenger to be quite serious. Primarily, Aristotle would think that it is necessary that a challenger first provide an alternative justification for the belief that there are individuals that can be in motion in the first place. That is, because Aristotle took the skeptical views espoused by Parmenides (there cannot be more than one being) and Heraclitus (there cannot be real change) to be fundamental problems for metaphysics,[18] he would not take

[18]That the doctrines of these two thinkers were considered seriously troublesome by Aristotle is evidenced by the fact that he spends the entirety of *Physics* Book I formulating the response to them. See 184^{a} 10-192^{b} 8.

seriously any characterization of nature that did not first justify a belief in real individual objects and real change.[19] [20]

In summary, while it is by no means apparent that these four possible identifications of place are the only ones available, it is not unreasonable to think that they could be, or at least that they should have been taken as such by Aristotle. Thus, a satisfactory answer to the second question, "Why are the possible identifications of place limited to the four presented?" has been provided.[21] As a result, there is one final question to address in order to satisfy the aim of this section, which is to present the Aristotelian incoherence argument as based upon reasonable (object-sidedly-consistent) assumptions. The question to which we now turn is "What, exactly, is the *exact nature* of place?"

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[19]In addition, Aristotle is inclined to think that a position which espouses fewer conditions would be best. Thus, the aforementioned alternative solution must not only account for both individuation and change simpliciter, but it must be able to do so either (a) in terms of a single principle, (b) in terms of two more favorable principles than matter and form, or (c) in terms of more than two principles, but only after he has shown that the Aristotelian two-principle solution is unsatisfying. Of course, none of these alternatives is a conceptual impossibility. However, with two thousand years of hindsight, it is pretty clear that alternative one- or two-principle construals that better solve the problems at hand have not been offered. However, it is the case that some later thinkers (e.g., Aquinas and Scotus) have adopted approach (c), contending that the two-principle solution falls short, and have proposed additional principles.

[20]A number of post-Aristotelian thinkers have apparently rejected not only the hylomorphic solution, but even the concern for addressing the Parmenidean and Heraclitean problems in the first place. Hence, whereas one who reads Aristotle and those committed to the Aristotelian tradition will find the problems addressed regularly, this is not the case for one reading modern and contemporary non-Aristotelian metaphysical treatises. That so many thinkers have seemed to take this approach (even if unwittingly) is interesting. For it should bring to mind the Kuhnian contention that distinct paradigms often give rise to a concern for distinct problems as well as distinct problem solutions. Hence, one might wonder whether the concern for the Parmenidean and Heraclitean puzzles is the effect of some more fundamental, yet non-necessary disposition that Aristotle is given to. If it could be determined that having concern for the Parmenidean and Heraclitean problems is not a object-sided requirement, and so that simply dismissing the problems is not unreasonable, then Aristotle could be challenged in a fourth way.

[21]Even if the concerns of Aquinas and Scotus are legitimate, that additional principles must be proposed to provide a fully satisfying solution to the Parmenidean and Heraclitean puzzles (see n. 19), it seems that whatever new features are given, they would fail to introduce a true alternative for escaping Aristotle's identification of place with an extrinsic limit. For the new intrinsic features would appear to be subject to the same challenges that prevented form, matter, and extension from being adequate alternatives – they would not be able to satisfy the requirement that place be both distinct from and abandonable by an object. Therefore, the pro-void opponent of Aristotle would most likely need to either challenge the doctrine that an appeal to abstract extrinsic causes could not be a viable explication of the extensional facts, or to reject the concern for the problem altogether. While identifying these paths to escaping the incoherence argument may not seem of great significance right now, I wanted to point them out because, when I get to the Newtonian response in §7.III, I show how taking one of these approaches proves to be the likely route.

7.II.B.3 The "Exact Nature" of Place

So far, a satisfying explication of the assumptions underlying the first two questions has been given. Now, I consider what was meant by the appeal to the "exact nature" of place. First, a recap. Earlier, I made the following statement: "the *exact nature* of the innermost motionless boundary is contingent upon a number of extrinsic features, for instance the pliability and density of the surrounding body." I followed this statement with the claim that "to be contingent upon another with respect to one's *exact nature* is to have an accidental mode of existence, which is contrary to being substantial by definition." In this sub-section I explain both of these statements. By doing so, I show that these statements are reasonably held. But, before addressing them directly, it is helpful to first consider whether there is just one way that "exact nature" *must* be understood. To do so, I offer a few additional versions of the pillow thought experiment.

In the most recent version of the thought experiment, there was an unmoving pillow that was the only object in an expansive universe. In that scenario, it was claimed that it would be appropriate to speak of the pillow as being in a place. I now want to propose a new set of qualifications on the scenario. First, let's suppose that the spatial expanse just happens to be shaped exactly as the pillow. Let's also suppose that the pillow is exactly in the center of the expanse and measures 2 ft. long, 6 ft. wide, and 4 in. deep. Now, let's make the spatial expanse to be 6 ft. long, 18 ft. wide, and 1 ft. deep. A simple calculation reveals that the pillow takes up 4 $ft.^3$ of the expanse, which is a total of 108 $ft.^3$ Thus, the place of the pillow is (roughly) the central 3.7% of the entire spatial region. I refer to this scenario as [S^1].

In the original version of the pillow-scenario (see §7.II.B.1), it was stated that the spatial expanse was mechanically inert. Let's suppose that this remains the case. Now, imagine that the expanse itself is shrunk in half so that its limits measured 3 ft. long, 9 ft. wide, and 6 in. deep.

Because the spatial expanse is supposed to be mechanically inert, no pressure is imputed onto the pillow when this occurs, so the pillow retains the same measurements and, thus, remains 4 ft.^{3}. However, given that the expanse is now just 13.5 ft.^{3}, the place of the pillow is (roughly) the central 29.6% of the entire spatial region. I refer to this scenario as [S^2].

Finally, consider a third scenario, where the spatial expanse is no longer supposed to be mechanically inert and that every region, including the pillow-filled region, is equally dense. Now suppose that some undefined force compresses the limits of the spatial expanse and shrinks it to half of its original size. The total magnitude of the expanse is now 3 ft. long, 9 ft. wide, and 6 in. deep, just as was the case in [S^2]. However, in this new version of the scenario, because the medium is mechanically efficacious and totally dense, the region containing the pillow is also instantaneously compressed and, so, the area occupied by the pillow is shrunk in half as well. Therefore, the pillow-filled region is now 1 ft. long, 3 ft. wide, and 2 in. deep. As such, in this final scenario, the pillow takes up just ½ ft.^{3} of the expanse, which is itself 13.5 ft.^{3}. However, the pillow's place of residence is, once again, the central 3.7% of the entire spatial region. I refer to this scenario as [S^3].

Given these three scenarios, a question arises. Which of S^2 and S^3 is better identified as representing the pillow as occupying the same place as in S^1, if either? How one answers this question, I think, will help one to see what she is inclined to identify as the exact nature of place. If one thinks that S^2 is the better candidate, then this person is more likely to identify the measurable, geometrical character of the object's extension as the "exact nature" of its place. On the contrary, if one thinks that S^3 is the better candidate, this person is more likely to identify some dispositional feature of an object's situation as the "exact nature" of place. I am confident

that one who rejects both of these options could be found to identify something else as the "exact nature" of place, though I won't speculate on the possible alternatives.

So which of these is Aristotle inclined towards? I think that one could make the case in either direction. The proposal I have advanced, concerning the contingency of this "exact nature" upon extrinsic features such as the pressure and pliability of the medium, seems less favorable to S^3, for the extrinsic features in that case do not prove to have any effect on the identification of the pillow's place, whereas it is the absence of such features in S^2 that allow for the original place to be retained. Therefore, if my gloss on Aristotle's doctrine here is accurate, he would identify the exact nature of a thing's place as the measurable extensional limits that a thing possesses. And these limits, it is clear, are not entirely dependent upon either the medium itself or upon the object that stands in the place. Rather, the limits depend upon the relation that stands between an object and its container – the proportional effects that follow from the density and resistance qualities of each object. As a proportional relation, it is clear that the place of an object is an accidental feature and, given Aristotle's ontology, cannot be treated as a substance.

But, as I have admitted, this is just my gloss on Aristotle's position, not an implication. So what if Aristotle were to claim that S^3 is the scenario where it is more appropriate to identify the place as being the same as S^1? Is it possible that the exact nature of place be characterized as substantial in that case? To answer this question, let's first identify the "exact nature"-making attribute of that position. In the event that Aristotle would commit to this view, it seems that the appropriate identification of the exact nature of place would be either the proportion of volume that the object shares to the whole, or the proportion of distance that lay between an object's extremities and its center and the limits of the whole and its center (or something similar). But, it is clear, we are again dealing with proportions between things, which are always relational facts

in an Aristotelian ontology. And relations are unequivocally categorized among the accidents of being in his ontology. Therefore, place is necessarily non-substantial in this interpretation too.

So it is not entirely certain how Aristotle *should* understand the appeal to the "exact nature" of place. Nonetheless, whichever way he would fall on the scenario given above, it does follow that the "exact nature" of place is to be understood, minimally, as an accidental feature of an object. And an accident, since it is by nature dependent, is contrary to substance and so cannot be treated substantivally. To do so would result in incoherence.

7.III A NEWTONIAN RESPONSE TO THE INCOHERENCE CLAIM

In order for Newton's commitment to the existence of extraterrestrial void to be upheld, he needs a conception of place that does not fall prey to Aristotle's incoherence argument. In this section, I consider how Newton could respond to the Aristotelian arguments formulated in §7.II.B and identify such a conception. Thus, this section is divided into three parts, matching the structure of that section. In §7.III.A, I show that Newton agrees with Aristotle concerning the essential features of place. In §7.III.B, I show that Newton disagrees with Aristotle concerning the possible candidates for the character of place. And in §7.III.C, I show that Newton agrees with Aristotle concerning the "exact nature" of place. The Newtonian responses make it clear that a pro-void argument can be upheld that does not treat place as a substance, and so does not result in incoherence, at least not for the reasons that were proposed by Aristotle.

7.III.A Concerning the Essential Features of Place

In order to proceed, one must first consider whether Newton would accept the "essential" features of place that Aristotle thinks are troublesome for a pro-void theorist. These are:

(1) Place contains things without ever being a part of them.
(3) Place must always be separable from the things it contains (i.e., it can be evacuated).

If Newton would affirm these features, then we must move forward to consider whether he has alternative candidates for the identification of place or whether he has an alternative conception of the "exact nature" of place. As we will see, I think that he would affirm them.

Newton offers a direct statement about place, which is found in "de Grav." There, he contends that "place is a part of space which something fills completely."[22] With respect to (1) then, Newton definitely *seems* to agree that place is to be distinguished from the things that reside in it. That is, he seems to agree that place is a container for a thing(s). However, Newton qualifies this statement in a way that, as we will see, has great significance: "as *only bodies are here considered and not penetrable things*, I have preferred to define [place] as the part of space that a thing fills"[23] (emphasis mine). The things that are contained by place are those which are impenetrable and not those which are penetrable. I explain this distinction below. Nonetheless, since only the impenetrable things can enter into a place, we can at least infer that place is not a part of those things.[24] Therefore, (1) is qualifiedly satisfied. Place is not part of an impenetrable thing. Nevertheless, as it stands, Newton leaves it open that place can be a part of a penetrable thing. So there is still some work to be done.

Let's consider the distinction between impenetrable and penetrable things in more detail. First, for Newton, impenetrability is a necessary feature of all bodies. It is that quality of bodies that makes it impossible that two bodies could occupy the same place. This characterization of

[22]Isaac Newton, *de Gravitatione*, 13.
[23]ibid.
[24]At least they are not initially a part of the things. I suppose that, on the basis of this statement alone, Newton could hold to the strange place-collector view mentioned in §II.A. That he does not hold such a view is evidenced by the fact that he also imagines place as evacuable. This will be argued in the following paragraphs.

bodies is maintained throughout *de Gravitatione*.[25] It is also consistently upheld in the *Principia*. As the editor to the second edition explains:

> All bodies for which we have observations are extended and mobile and impenetrable; and from this we conclude that all bodies universally are extended and mobile and impenetrable, even those for which we do not have observation.[26]

Finally, there is no reason to suppose that Newton ever rescinded this characterization. In fact, he repeatedly reaffirms it in the latest editions of his last major scientific work, *Opticks*.[27]

But, if all bodies are impenetrable things, what, if anything, can be characterized as a penetrable thing? The answer to this question should not be surprising given our understanding of Newton's doctrine of space. For, as was expressed in the previous chapter, Newton identifies space with the sensorium of God (see §6.II.D). Now, the sensorium of God is definitely considered to be a thing. What's more, it is a thing that is extended but which lacks the qualities which allow for the distinction of bodies from one another (e.g., mobility, tactility, and *impenetrability*). In short, the divine sensorium is roughly the ontological backdrop for all of material being. In fact, in one section of "de Grav," Newton identifies bodies as simply the regions of the sensorium which God has freely chosen to imbue with impenetrability![28]

As a result of this distinction, how should we relate the Newtonian position to Aristotle's feature (1)? One way that we could do this is to qualify (1) so that it more accurately reflects the distinct Newtonian doctrine. Thus, instead of (1) "Place contains things without ever being a part of them," we could take Newton as committed to (1*) "Place contains *bodies* without ever being a part of them." This way of relating the two doctrines seems to imply that Newton rejects the

[25]c.f., Isaac Newton, *de Gravitatione*, 13, 28, 30.
[26]Isaac Newton, *Principia*, 391. This statement is easily applicable to Newton himself. For, in Book III of the *Principia* he identifies it to be a "rule for the study of natural philosophy" that impenetrability be understood as a "property of all bodies universally" (795).
[27]Isaac Newton, *Opticks*, 389, 398, and 400.
[28]Isaac Newton, *de Gravitatione*, 28 ff.

first Aristotelian feature and that Newton's justification for the rejection rests upon his general ontology concerning the nature of space.

However, there is another way that the Newtonian and Aristotelian systems could be related with respect to (1). For if we allow that Newton would agree with the pillow thought experiments in §7.II.B.1, especially the earliest version where it was contended that the term "place" was not appropriately applied to an object that takes up the entirety of a spatial expanse, then he might simply say that "things" in (1) implicitly excludes any object that is not able to be characterized as in a place. I call such things non-place-worthy things. In fact, Newton could also contend that the Aristotelian interpretation of (1) is committed to a distinction between place-worthy and non-place-worthy things; for the entire Aristotelian universe can be spoken of as a thing and, yet, it does not satisfy (1). That is, the universe as a whole is a thing, yet it is not contained by another body; so it is not the case that place contains all things. Likewise, since Newton's sensorium is a non-place-worthy thing, it should not be counted as an object that causes a conflict with Aristotle's (1). Hence, Newton can be thought to accept (1) in the same spirit that it was understood by Aristotle.

It is also the case that Newton could affirm (3), that a necessary feature of place is that it can, in principle, be evacuated by impenetrable, place-worthy things. Recall one of the challenges to Cartesian doctrine that was discussed in §6.II.C. In the penultimate paragraph of that section, Newton's argument that a Cartesian physicist cannot actually sustain physics was given. In the midst of the attack on Cartesian natural philosophy (in "de Grav"), Newton asks "if the place of the planet Jupiter a year ago were sought now, by what procedure, I ask, can the Cartesian philosopher describe it?"[29] Clearly, Newton thinks that the one engaging in physics should be able to accomplish this task; otherwise, this question would be without any rhetorical

[29]Newton, de Gravitatione, 19.

weight. That is, if place were not presupposed by Newton to be evacuable, at least for objects such as Jupiter, then this could not have been taken to be a serious difficulty for a Cartesian. For, the Cartesian need only locate Jupiter in the sky, point at it, and respond to Newton as follows:

> Isaac, do you not believe that place is not evacuable for impenetrable objects? And do you not also believe that Jupiter is itself an impenetrable object? But, then, it follows that the place of Jupiter a year ago is the place of Jupiter now!

Of course, based on what has been established concerning the distinction between penetrable and impenetrable things, it is clear that Jupiter is among the impenetrable objects in Newtonian natural philosophy. Therefore, if it is supposed that Newton was committed to a non-evacuability thesis, that is, to a rejection of (3), it is clear that he could easily be made to appear the fool by treating this question as significantly problematic for a Cartesian. But, because it is uncharitable to suppose Newton to be guilty of such obvious indiscretion, I think it is more appropriate to interpret him as if he is committed to (3).

Again, one could wonder whether Newton would be unqualifiedly committed to (3). Thus, instead of agreeing with the statement "Place must always be separable from the things it contains," perhaps it would be thought that Newton should restate it as (3*), "Place must always be separable from *bodies*." Technically, this would be more accurate. But, again, Newton could respond that this does not distinguish him from the original Aristotelian conception because, in Aristotle's view, the things of consideration were presupposed to be place-worthy things (for the same reason noted above). Thus, it does not amount to a true distinction between the Newtonian and Aristotelian conceptions of place if not all Newtonian things could be said to be capable of evacuating some place. For neither could all Aristotelian things accomplish this.

Thus, given that Newton seems to accept the apparently problematic features of place that are identified by Aristotle insofar as "things" are understood to be "impenetrable" or "place-

worthy," and given that there is at least some reason to think that Aristotle, if pressed, would also have to accept a qualification distinguishing place-worthy from non-place-worthy things, I think it is fair to announce that Newton is in agreement with Aristotle concerning the essential features of place. Therefore, if there is a serious problem with the Newtonian position, it will have to arise on the basis of one of the other two considerations.

7.III.B Concerning the Possible Candidates for Place

Now that it has been shown that Newton and Aristotle would agree about the relevant necessary features of place, I must consider whether Newton offers a new candidate(s) for the identification of place that will serve to distinguish him from Aristotle. I show that he does, and that the new candidate is his infamous sensorium of God. Thus, I consider here whether his characterization of place as part of the sensorium runs into the difficulties expressed in §7.II.B.2, or whether there is a viable explanation that allows those problems to be avoided.

To begin, let's presume, for the sake of argument, that Newton would be qualifiedly satisfied with Aristotle's identification of place as the extremities of a place-worthy object.[30] Preliminary support can be offered for such an identification: because Newton has already been shown to be committed to the thesis that a place-worthy object must be separable from its place, nothing intrinsic to an impenetrable being can be the ground of its place. Hence, Newtonian place should be considered an extrinsic feature. Given that the only extrinsic option for identifying place in the Aristotelian model was the extremities of an object, it makes sense to start with that option and to see whether it should be qualified or ruled out.[31]

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[30]That it would not be satisfactory for an identification with the extremities of the penetrable object, the sensorium, can be shown in the manner that I argued above; the sensorium is not a place-worthy object to begin with.

[31]A nice corollary of making a presumption in favor of the "extremities view," is that any concern for what Newton might have thought about Aristotelian hylomorphism is ruled out as unimportant with regard to the issue of void's existence. More generally, we may avoid the difficult task of trying to discover what Newton's exact position

If Newton is to escape the worry of Aristotle, then he ought to be able to make a division between abstract and materially extrinsic causes and, thus, to reject the proposal that an appeal to abstract extrinsic causes is not a viable way to make sense of the facts concerning the exact extensional limits of place-worthy things.[32] In fact, it turns out that this is exactly the approach that naturally fits a Newtonian view. Before demonstrating this, however, I should acknowledge that I assume that a Newtonian penetrable being is an adequate instance of an abstract extrinsic cause. I take it to be abstract because it lacks mechanical causal properties. I take it to be extrinsic because it is distinct from the place-worthy things under consideration. I take it to be a cause because it is supposed to have empirical effects.

Now, for Newton, there is no obvious reason to suppose that the extremities of one impenetrable being must depend upon the mechanical influence of another impenetrable being. Rather, in his system, the extensional limits of an impenetrable being are the result of the will of God, which needs no mechanical action to take affect. Simply, Newton would contend that Aristotle is more naturalistic than the object-sided world demands. In other words, there is no need for a reasonable scientist to make such strong naturalistic commitments regarding the causal powers of abstract extrinsic beings. If it is conceivable that a God exists who has formed the world through its own sensorium, then there is no conceptual problem with the additional supposition that this God has given impenetrable objects their character without requiring this God to use mediating mechanical tools to accomplish the task. In fact, to demand that such tools be involved leads to an explanatory regression; for the tools would, presumably, be extensionally

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regarding the Parmenidean and Heraclitean problems might have been. To my knowledge, he never directly addresses these concerns; so I think it would have been a very difficult task to formulate his opinion on these matters with any degree of confidence.

[32]My justification for this is established on the basis of the options for challenging Aristotle identified in §7.II.B.2. There I argued that one could challenge the Aristotelian view by adding intrinsic options or subdividing the extrinsic option according to the material/abstract condition. Since I rule out intrinsic options off the bat, then the latter is the best left on the table.

limited as well, and so would also require the mediation of other mechanical tools, and so on and so on.

Whatever one might think about the theistic hypothesis, it seems right to say that it is not obviously ruled out by the object-sided world. Moreover, theism as a metaphysical hypothesis is not an irrational one as far as I can tell. I do not mean to say that it is entirely unproblematic, but just that there seem to be varieties of it that do not lead to explicit contradiction. Further, whether it is the case that Newton's sensorium-model of theism is a non-problematic version is unclear to me, but it is at least not an obviously absurd view, even if it is admittedly strange.[33] Therefore, it seems that Newton has provided an alternative model for characterizing place. Deeper reflection is needed to see whether this model can be consistently upheld. But that project involves concerns that are beyond my immediate aims, and so I will not take it up here.

7.III.C Concerning the "Exact Nature" of Place

Thus far, I have shown that Newton is able to disagree with Aristotle concerning the identification of place without espousing an obviously incoherent view. But it remains to be seen whether a doctrine of the "exact nature" of place can be formulated that is not subject to the Aristotle's incoherence charge. In order to accomplish this, I first explain that the thought experiments used to characterize the "exact nature" of place for Aristotle are not useful for the characterization of the Newtonian view. I then go on to explain Newton's view concerning the the "exact nature" of place in a different manner, and I contend that it seems to be consistent with Aristotle's own conception. I complete this section by addressing the worry that Newton might be guilty of making an accident to be substantial. I show that he is not.

[33]If anything, it sometimes comes across as a version of theism that shows concern for certain elements of pantheism. But pantheism is not obviously absurd either.

To begin, it must first be admitted that the thought experiment used to identify the exact nature of place for Aristotle (the comparison of [S^1] to [S^2] and [S^3]) cannot be rendered possible under the Newtonian worldview. The reason that it worked for Aristotle is that his natural philosophy is committed to a finitely extended universe. On the contrary, Newton maintains that space is infinite because God is, and space just is the penetrable sensorium of God. So, unless God's being can be made finite or shrunk in half, it is inconceivable that the limits of space could themselves be established or shrunk down. To allow such an action would result in a seemingly serious conceptual problem for a theist who primarily identifies God as an infinite being, which Newton clearly does. So, if we wish to delineate a doctrine of the "exact nature" of place for Newton, we must take some other approach. Extensional proportionality will not be involved.

Thankfully, I have already described the Newtonian view in enough detail to draw out an adequate description. Broadly, I think that Newton agrees with Aristotle that a thing's place is its extensional magnitude. But, whereas Aristotle has identified the magnitude of place as the innermost motionless boundary of *a containing body* at which points it is in contact with a contained body, Newton would identify the innermost motionless boundary not as between a containing and contained body, but as between a part of God's sensorium where impenetrability is manifest and a part of God's sensorium where impenetrability is not manifest.

This rendering seems to help avoid the problematic implication that place be taken as a substance in order to substantiate a pro-void position. For the limits of the contained body on the Newtonian view still seem to be based upon an accidental feature of reality. That is, Newton's view takes the qualitative presence of impenetrability to be the distinguishing feature of a place-worthy object's place. And qualities according to Aristotle are accidental. Of course, that exact character is no longer dependent upon a mechanical relationship between two beings, the place

worthy object and the surrounding body. Rather the volitional act of God establishes a new qualitative character of part of his sensorium non-mechanically, and this amounts to the creation of a new being with its own extensional limits. Nonetheless, the exact extensional character remains accidental since the object's extensional limits are determined by something extrinsic.

I do not see any reason to suppose this to be problematic for Newton. For he does not take "place" to be substantial, but space is. And place and space are not identical for him any more than a containing body and place are identical for Aristotle. Thus, the real points of disagreement are whether (a) a penetrable extensional being is possible, and (b) the containment of an impenetrable being can be a non-mechanical effect of a penetrable extensional being. Reason does not demand an obvious answer to either of these questions. Therefore, we are left wondering whether the incongruence between Aristotle and Newton is solvable, even if only in principle.

7.III.D Summary So Far

To this point, a number of tasks have been accomplished in this chapter. First, in §7.I, I showed that the object-sided world is capable of resisting Aristotle's empirical system in general, and that this failure necessitates a rejection of his empirical anti-void arguments. After this, in §7.II, I considered the non-empirical argument that Aristotle offered against the pro-void view, namely that the conception of void is incoherent because it involves treating place as a substance. In that section, it was shown that the non-empirical Aristotelian argument is reasonable. For it seems to be appropriately derived from Aristotelian metaphysical concerns and is not clearly incompatible with the object-sided evidence. Then, §7.III, I showed that Newton can disagree with Aristotle about the character of place without being guilty of treating place as a substance. Thus, I have one final task ahead of me, which is to clearly show that the disagreements in play

are not solvable by direct appeal to object-sided reality, but rather that they rest upon what has previously been identified as a subject-sided moment of experience – an act of conceptualization where the important elements are freely created by human cognition.

7.IV THE SUBJECT-SIDED CHARACTER OF THE DISAGREEMENT

In this final section, I want to connect the points of disagreement highlighted above to what I have identified as subject-sided features of empirical experience. First, I think that it is convenient to reformulate the disagreements as a pair of questions. Then I want to consider how one might go about answering these questions. The latter step helps to expose the subject-sided nature of the inquiry. The questions are:

(D1) Is a penetrable extensional being possible?
(D2) Can something be extensionally limited by a penetrable being?[34]

Concerning (D1), we must not understand by "penetrable extensional being" merely that the object in question can be passed through, as a screen door is penetrable by air, but rather that the object in question cannot occupy the exact same place as another object, as the particular atoms of the screen are not supposed to be able to share an exact location with the atoms of nitrogen in the passing air. With this refined conception in mind, we can reformulate the question as follows:

(D1*) Can two extended beings occupy the exact same place?

To answer this question, let's conduct a new thought experiment. In a storyline from the TV drama *Fringe*,[35] a group of technologically savvy bank robbers obtain a special device that allows them to walk through the thick walls of a bank's vault. Unfortunately, during a botched mission, the device malfunctions and one of the robbers is not able to make it all the way through the vault and gets trapped in the steel wall, which leads to his immediate death. In the context of

[34]Of course, I don't suppose these to be the only possible questions. I don't see others as pressing though.
[35]Season One, Episode 10.

the story a "scientific" explanation is provided in order to account for both the ability to pass through the wall and the fact that the malfunction led to the unlucky crook's entrapment and death. The device was used to put the particles of the vault wall into rapid motion so that a more stable solid body could pass through. One can envision this as being analogous to the unfreezing of a frozen bottle of water so that a straw can be inserted and the refreshing drink enjoyed. The reason the crook became trapped and then crushed to death was that the motion of the vault-particles was quickly decelerated and, thus, the body could no longer evade the resistance of the vault-particles in their natural state. This is analogous to an instantaneous refreezing of the water as the straw is halfway in; the previously free straw would get stuck in its place.

It is pretty clear that the supposition involved in the storyline is that the criminal was able to pass through the wall because the impeding particles were easily moveable and not because the particles of his body were able to occupy the same exact places as the particles of the wall. Likewise, we do not suppose that the particles of the straw actually share the exact location of the frozen water particles. Instead, we imagine that the particles of the vault/bottled water are simply repositioned so that the more solid body/straw was able to pass through the less solid vault/bottled water.

But let's adapt the scenario, supposing that the person stuck in the vault wall remains alive and well and is able to report that he experiences no feelings of resistance, pressure, or discomfort. Would not this new evidence be equally consistent with an interpretation that would explain the entrapment in the terms of two extended things that were in the same place? In fact, let's make the situation even more fantastic, allowing the person to move back and forth through the wall at will. Neither of these scenarios seems *conceptually* impossible, even if incredibly

surprising and highly unlikely.[36] What I want to know is, is it possible in such a case to suppose that at least some of the particles belonging to the trapped criminal really are, at some times, in a state of extensional overlap with respect to the particles in the vault's wall? I must admit that I cannot determine that such an interpretation is impossible.

At the same time, however, I find it exceedingly difficult to imagine that a circumstance such as this can actually occur. Why? Perhaps it is because I accept a notion of extended being that closely resembles the Newtonian conception of body as an impenetrable object, but which is inconsistent with his admission of penetrable extended substance. I suppose that my inclination is supported by my object-sided perception of the physical world; for example, I have never seen one material body pass through another, but I have often seen such bodies deflect when they run into one another. At the same time, I recognize that these observations are not sufficient to make the absolute claim that matter *must* be impenetrable. Nonetheless, I am inclined to allow the presupposed "necessity," that all extended being is impenetrable, to influence my disbelief of the possibility that two material objects could reside in exactly the same place at once.

What's more, one cannot simply charge that my inclination to accept the impenetrability interpretation is the result of a logical mistake – that I am foolishly ignoring the problem of induction. I consciously recognize that to make that absolute claim without qualification is to be guilty of a logical fault. So I consider myself as making the inference on neither a strictly empirical nor a logical basis. So if the observations alone are not sufficient to make the move from "all matter that I have seen appears to be impenetrable" to "all matter is impenetrable," and if no logical rule supplies a total justification for the inference, then on what basis do I make the inference? The inference is made because *I have chosen to universalize the conception by settling the definition* of "extended being." In other words, I have chosen to be satisfied with a

[36]The conceptual possibility of such activity may also be evident in the broad curiosity with ghost stories.

linguistic convention, a definition of a term in the English language, that implies the apparent absurdity of any hypothesis that makes use of the claim that there are two extended beings in one place.[37] In Kuhnian terms, I have determined that this definition of extended being has a place in my scientific lexicon and that all of empirical experience must be understood in a manner which is consistent with the definition.

And linguistic conventions, as argued in Chapters Two through Four, are subject-sided. That is, they are mental constructs which are not given by the object-sided world itself. Thus, whereas the object-sided world may in fact suggest a certain level of appropriateness in formulating the definition of "extended being" in the way that I have done, insofar as my decision was made only after I saw that there was prior consistency between the concept and my experience of distinguishable beings, it does not absolutely demand it, and, thus, does not guarantee that the true character of extended being is to possess the attribute of impenetrability. As a result, I must admit that it is at least conceivable that a pair of objects with extensional magnitude share the same place. So Newton seems to be allowed by the object-sided world to uphold his primary assumption, that extended substance can be either penetrable or impenetrable, and that it is possible that a penetrable and an impenetrable extended being might coexist in the exact same place.

At the same time, there does not seem to be anything wrong with doubting that this latter circumstance is, in fact, occurring in the revised vault-case above. The object-sided world does not inform us that there really are instances of objects in a state of extensional overlap. In fact, the object-sided world is simply ambiguous on the matter. Perhaps the person in the vault wall feels no pressure from the wall, or is able to move back and forth through it, simply because it

[37]Of course, I don't take this decision to be completely arbitrary. I think it is well-informed empirically and, in general, it is a very reliable decision to have made. But these don't *fully justify* it.

happens that the exact arrangement of impenetrable object's needed for the event to occur obtains. Hence, the anti-Newtonian has reasonable access to the alternative beliefs that such overlap does not occur and that two extended beings are not residing in the same location.[38]

So what about (D2), can something be extensionally limited by a penetrable being? One's answer to this question will, in part, depend upon whether one thinks that there is a penetrable being in the first place and what that being's causal capabilities might be. If the Newtonian God or any being with relevantly similar powers is granted as a possible being, I see no way that such a limitation can be necessarily disallowed. At the same time, I can understand why one might scoff at any appeal to penetrable-yet-extended beings in order to advance a scientific thesis. Thus, I don't find an anti-Newtonian suspicion to be unreasonable. What's more, I highly doubt that the object-sided world could offer any information that would help to determine the appropriate attitude towards the possibility that such a being exists. As a result, it seems that the decision as to whether I should allow for the non-mechanical causal efficacy of a penetrable being is up to the one who is worried about such matters and will likely depend on whether their current lexicon either demands it or, more loosely, can sustain it.

7.V CONCLUSION

In summary, I have argued that the disagreement between Aristotle and Newton over whether or not void exists is a hallmark case of scientific incommensurability in play. What either thinks to be true concerning this matter depends on his linguistic apparatus, dispositional tendencies with respect to the seeming value of certain questions, dispositional tendencies to find

[38]If this is granted, then it creates a whole lot of trouble for the Newtonian account, not the least of which it would prevent the ubiquity of God by making the sensorium unable to extend to those locations where bodies reside. I suppose that an appeal to the sensorium without the ubiquity would be without value to Newton. Thus the question of void's existence would no longer be a matter of concern, at least not without some newfound empirical problem to solve.

certain solutions to be satisfying, and perhaps a number of other factors. Thomas Kuhn's philosophy of science has accounted for all of these facts of experience and his view, at least as it has been developed in the present work, has been shown to be plausible. In fact, I do not think any other view can explain either this controversy or many others in the history of science quite as well.

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